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EDITORIAL.

Padi Experiments.

The account of padi experiments carried out during the season 1931—32 contained in this number, should be regarded as a continuation of those detailed under the heading of "Padi Experiments in Malaya 1930—31", on page 577 of the December 1931 issue of this Journal, and if read in conjunction with the latter, the general progress which has been made can be readily visualized.

There are now a total of five Padi Experiment Stations and nineteen Padi Test Plots distributed throughout the more important padi-growing districts of the Peninsula. The five Padi Experiment Stations, which are of larger area than the Test Plots, are situated at Pulau Gadong in Malacca, Krian and Talang in Perak, Bukit Merah in Province Wellesley and at Teluk Chengai near Alor Star in Kedah. These stations exist for the purpose of selecting pedigree strains, of evolving hybrid strains and testing their suitability to local conditions, the multiplication of seed stocks and their distribution to cultivators, and for experiments in manurial and general cultivation methods. All these Stations are under the direct supervision of the Agricultural Field Officers in the various States, where in each case, the programme of work is carried out on similar, general lines.

The Padi Test Plots are established, also in a wide geographical distribution, with the object of carrying out similar varietal trials on a smaller scale, and as centres for the multiplication and distribution of the seed of proved, successful varieties. These plots are generally in the charge of trained Malay officers of the Department of Agriculture and are supervised by the Agricultural Field Officers concerned. Nine of these plots were planted for the first time during the season 1931—32. The results of the work on all these plots and stations are demonstrated to the padi planters, and the interest taken by them in these activities is clearly shown by the increasingly large numbers who attend such demonstrations.

As is only to be expected, in connection with padi planting, about which the Malay has built up an elaborate series of immemorial traditions and conventions, no innovation is going to prove immediately acceptable, and therefore

the work of popularising scientifically proved methods of cultivation and pedigree strains of seed is, of necessity, slow. Furthermore, in the matter of these strains, which from their high yield figures it would be thought had adequately proved their worth, there is often a definite prejudice, real or imaginary, against the milling and cooking qualities, the flavour and the nutritive capacity. Thus, it frequently happens that although after several years of trial certain types of padi have been satisfactorily proved to give yields which are consistently higher than those obtained from the popular local varieties, the demand for such seed is remarkably small.

In spite of the foregoing, it can definitely be stated that in a number of areas, the planting of tested and selected seed has increased among the Malay cultivators in the neighbourhood of experiment stations and test plots, and therefore one is led to believe that it is only a question of time before the results of frequent ocular demonstrations will have the desired effect.

Since a marked preference has recently been shown among cultivators for padi which has a short maturation period, more especially in districts where flooding may be the cause of considerable damage, efforts have been made to evolve strains which, while they mature early, retain the desirable qualities of the long-term varieties.

The manurial experiments described in this number which were carried out on five Padi Experiment Stations, have again led to the conclusions reached in previous years; namely, that only in localities where the normal yield is considerably below the maximum yield, have notably increased crops been obtained by the use of fertilisers.

The results of this year's work tend to justify the belief already held that there is a definite maximum yield beyond which manuring on orthodox lines has no significant effect upon the yields of wet padi.

The maximum yield generally possible is held to lie somewhere in the region of 400 to 500 gantangs per acre, and in general, attempts to force yields above this point have been entirely unsuccessful. It is by no means clear whether this is due to conditions inherent in the soil or in the plant, or even possibly to a combination of the two.

There is no question, on the one hand, that compared with rice yields which are obtained in various other rice-growing countries *e.g.* Japan, Italy or Spain, the limit of yield envisaged above is very decidedly low, while on the other hand, it is equally clear that in favoured places in Malaya itself these maximum yields are not infrequently exceeded, yields as high as 800—900 and even more gantangs being on record. It would appear that in certain places in Malaya, therefore, the limiting factors to yields which are normally strongly evident may be absent, and efforts are now being directed to the elucidation of the nature of the limiting factor in question.

An important point which is brought out in Part III of the paper in this Journal is that ability or otherwise of soils to grow a satisfactory crop of padi depends on the presence thereon of considerable quantities of organic material

of recent origin which undergo partially anaerobic decomposition under the water-logged conditions of padi fields. Experiments with various soils in specially constructed tanks at Serdang showed that on arable soils, unless the procedure was adopted of turning in considerable quantities of organic matter immediately before planting out the padi seedlings, the crop would not grow, but when this provision was observed, satisfactory growth was obtained. Soils taken from wet padi land that had lately been under padi did not, however, require this process. Taken in conjunction with the work of investigation in other countries on the application of green manures to padi soils and the observation in relation to manures recorded, it seems not beyond the range of possibility that some inter-connection may lie between the observed limitation of yields on padi soils in Malaya and the condition obtaining in relation to soil organic matter.

The subject is of importance and further developments will be awaited with considerable interest. A further interesting point dealt with is the effective size of plots which can be used in experiments with padi; formerly experimental reaping areas of 1/40 acre each were employed, but with the increase in the work consequent on the rapidly broadening horizon of investigation, it becomes a matter of importance to reduce the size of plots if possible. Statistical investigation of a large number of data obtained during the course of past years has indicated that the size of individual plots can be reduced to 1/120 of an acre without materially affecting the accuracy of the results, thereby enabling very considerable economies in space and effort to be effected and widening the range of problems that can be investigated at any one time.

The series of articles in this number is intended to be in the nature of a progress report and indicates those lines along which definite advances have been made; there are a number of other points under investigation, such as cultivation experiments, experiments on irrigation by pumping, work on insect pests of the crop, work on growing padi on reclaimed mining land, chemical investigation of the composition of different varieties, together with a large amount of effort on distribution of padi seed of which no mention is made in these papers. It is hoped in due course and when further results are available, to publish a full account of the Department's work on padi to date, in the form of a research bulletin.

Livestock Improvement in Ceylon

It is interesting to note that in the October number of the *Tropical Agriculturist*, under the heading of "Livestock Improvement in Ceylon", the editor comments upon conditions among the cattle of the peasant stock owners which somewhat closely resemble those obtaining in Malaya.

The rearing of livestock for milk on a small scale in Malaya is almost entirely confined to the Tamil and Sikh squatters whose herds of ill-nourished and unthrifty animals demonstrate the great need for improvement which exists.

The generally inadequate pasturage, seldom if ever augmented by proper

supplies of stall fodder, and the unsuitable and insanitary stalls into which the animals are herded at night, conditions which attract the attention of even a casual observer in Malaya, are, it would appear, even more prevalent in Ceylon than in this country.

The editor of the *Tropical Agriculturist* suggests that this neglect in Ceylon is due largely to the fact that dairy produce is not regarded as an essential part of the normal diet of the peasant, the coconut supplying as it does the fats necessary in human food.

The lack of interest in cattle farming among the Malays may certainly be attributable to the same cause; the buffalo is almost without exception, the only type of stock raised by the Malay, for use as a draught animal, for work in the padi fields and for slaughter. In spite of the fact that milk is comparatively little used in the Malay homestead, there is a slowly increasing demand for the condensed article among the more enlightened, and when one considers the fact that during the period 1929 to 1931 the average yearly value of milk of all kinds, imported into Malaya was $11,442,802 and of butter $3,168,810 (Straits currency) the large quantities consumed by the alien population can be realised and the need for greatly increased local production is appreciated.

EXPERIMENTS WITH PADI IN MALAYA 1931-32*

The papers which follow give an account of various aspects of padi research during the season 1931—1932. Tables I, II and III show the characteristics of the five Experimental Stations and nineteen Test Plots at which the work was performed. Results from Kedah and Perlis are included by courtesy of the Governments of these States.

The officers mentioned in Table I were responsible for demarcation, planting and recording and should be regarded as joint authors of Parts I—III of this article. Similarly, Messrs. J. N. Milsum, T. D. Marsh and J. L. Greig, Assistant Agriculturists, should be regarded as joint authors of Part IV.

In all the main padi areas the season was almost an ideal one as far as weather conditions were concerned, for well distributed rainfall was general throughout the padi growing period and dry weather at harvest reduced harvesting losses to a minimum, while pests, especially rats and padi stem borers, were less in evidence than has been the case for some years. Adverse conditions were, however, experienced in certain areas, notably in eastern Pahang where floods ruined much of the crops and in the coastal areas of Selangor, where exceptionally high tides coupled with very strong west winds resulted in the destruction of a large area of young padi, owing to the presence of salt water in the fields, a result which stresses the need for bunding flat coastal areas.

Experiments on the reclamation of recently mined land at Kamunting gave inconclusive results and will be continued.

Trials on different methods of cultivation before planting carried out at Bukit Merah, Selinsing and Telok Chenghai gave no definite results and will be continued for another season. (*W.N.C.B.*)

TABLE I.

Padi Stations Season 1931—32.

STATE	STATION	OFFICER IN CHARGE	METHOD OF IRRIGATION
Experiment Stations.			
Kedah	Telok Chengai	W. N. Sands	Rainfall.
Perak	Titi Serong	H. W. Jack	Krian Reservoir and Irrigation canal.
	Talang	H. D. Leighton	Dam in stream and conduit.
Province Wellesley	Bukit Merah	F. R. Mason	Rainfall, supplemented by dam in drainage canal and conduit.
Malacca	Pulau Gadong	C. L. Newman R. G. Heath	Dam and conduit, supplemented by pump.

*An account of field experiments with padi for the season 1930—31 was given in this Journal in December, 1931.

State	Station	Officer in Charge	Method of Irrigation
Test Plots			
Kedah	Jitra	W. N. Sands	
	Langgar	„	
	Sala Kanan	„	
	Rantau Panjang	„	
Perak	Bruas	H. D. Leighton	Dam and conduit.
	Bukit Gantang	A. E. Coleman-Doscas	Dam and conduit.
	Kamunting	A. E. Coleman-Doscas	Dam and conduit.
	Lenggong	H. D. Leighton	Hill stream.
	Selinsing	A. E. Coleman-Doscas	Krian reservoir and canal.
Province Wellesley	Glugor	F. R. Mason	Hill stream.
Selangor	Kajang	H. J. Simpson	„
	Kuang	„	„
Negri Sembilan	Kendong	W. H. Barnes	„
Malacca	Alor Gajah	C. L. Newman R. G. Heath	„
Pahang	Dong	J. Fairweather J. M. Howlett	„
	Pekan	J. M. Howlett	Conduit.
	Temerloh	J. Fairweather J. M. Howlett	Rainfall.

In addition there were two Test Plots in Perlis at Arau and Sanglang which were controlled by the British Adviser.

Table II.

Rainfall during the Growing Season.

Inches

Station	1931								1932.	
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Telok Changai ...			5.27	7.46	8.70	16.67	5.30	13.35	Nil	
Titi Serong ...	8.18	12.64	3.95	4.34	7.05	8.41	6.06	7.20	2.27	8.96
Talang ...	not available									
Kuala Kangsar 1½ miles distant ...	2.99	5.18	3.21	3.97	5.68	9.00	10.05	16.44	3.88	5.28
Bukit Merah ...	not available							11.97	.27	6.12
Butterworth 4½ miles away ...			4.37	5.33	5.38	13.78	5.77			
Pulau Gadong ...	17.00	11.93	11.49	6.09	19.60	7.95	9.65	9.76	2.44	2.82

Table III.

Soil Analyses (Top Soils)

(*a*) Mechanical.

Stations	Percentages.					
	Clay	Silt	Fine sand	Coarse sand	Gravel	Loss on Ignition
Telok Chengai ...	59	27	11	Nil	Nil	11
Titi Serong ...	51	35	10	Nil	Nil	12
Talang ...	44	24	18	9	2	12
Bukit Merah ...	47	12	33	4	Nil	7
Pulau Gadong ...	33	37	29	Trace	Nil	7

(*b*) Chemical.

Stations	Percentages.								
	K_2O	P_2O_5	CaO	Sesqui oxides	Fe_2O_3	MgO	N	C	pH Susp.
Telok Chengai ...	0.96	0.05	0.20	21.8		0.03	0.14		4.3
Titi Serong ...	0.53	0.06	0.03	26.2	3.47	0.01	0.19	1.6	5.4
Talang ...	1.09	0.08	0.22	23.3	4.19	0.41	0.22	2.4	5.2
Bukit Merah ...	0.22	0.04	0.05	17.7		0.03	0.21	1.3	5.2
Pulau Gadong ...	0.62	0.03	0.04	12.2	1.77	0.45	0.14	2.6	4.2

Part I.

BREEDING AND VARIETAL TRIALS.

BY

H. W. Jack, R. B. Jagoe and B. A. Lowe.

Test Plots planted for the first time this season are four in Kedah at Jitra, Langgar, Sala Kanan which gave useful results and at Rantau Panjang where the trials were damaged by floods; at Temerloh and at Pekan in Pahang, Kendong near Rembau in the Negri Sembilan; at Bukit Gantang and at Bruas in Perak all of which suffered in different degrees from various difficulties met with in opening up new land.

No results worth mentioning were obtained from Pekan and Temerloh.

Titi Serong Experiment Station, Krian.

The experiments at this station during last season included yielding tests of selected pedigree strains, the maintenance of pedigree and foundation stock lines, seed multiplication plots, field observation plots for recently introduced varieties, selection of suitable strains from recently introduced varieties, investigation of controlled hybrid populations, test of the amount of natural cross-pollination between different varieties in the field, manurial and cultural observations and the continuance of various meteorological records.

Despite the collapse of the irrigation spill weir during the season, a well distributed rainfall resulted in good growing conditions, while the harvest was favoured with fine weather, hence good crops were produced.

The varietal trial included seven long maturation period and 14 early ripening pedigree strains. These were tested in 6 replications randomised within blocks, and results showed that several of the long maturation strains were significantly better than several of the early ripening series vide Table II. No significant difference of yields were found within the long maturation series but the best yields were obtained from Seraup 371 (3,200 lbs. per acre), S.48 (3,140 lbs.), S. 68 (3,050 lbs.) S. 15 (2,990 lbs.) and S. 36 (2,880 lbs. per acre). S. 36 suffered loss of grain from overripeness.

Of the earlier ripening types, the best crops per acre in order of yield, were obtained from Radin 7, Radin 4, F.S. 756 (Nachin), Nachin 10 (a Nachin strain selected at Pulau Gadong, Malacca), F.S.55 (Mayang Kuning), Radin 13, Radin mixture, Siam 29 (also from Malacca), Radin 11 and Radin 2. Local popularity in the vicinity of the station, as gauged by the appearance of the crop in the field and of the grain after harvest, places Seraup 48, Seraup 36, Radin 4, Radin 2, Nachin 10 and Siam 29 in the forefront with a preference for Seraup 36 and Radin 4 in areas where water supply is abundant and Radin 2 where water is liable to be inadequate. Siam 29 and Nachin 10 produce good crops but possess weak straw which it is hoped to strengthen by crossing with strong strawed strains. Nachin F.S. 756 produced a good crop and has stiff straw.

Radin and Seraup mixture did fairly well but showed no improvement over pedigree strains.

Table I.

Yields from varietal trial, Titi Serong Experimental Station, Krian.

	Strain	Maturation period Days	lbs. per plot (1/109 ac.)	Standard deviation : lbs per plot	lbs. per acre	Standard deviation : lbs. per acre
Over 7 months	Seraup 371	240	29.3	4.5	3,200	490
	„ 48	240	28.8	2.4	3,140	260
	„ 68	240	28.0	2.4	3,050	260
	„ 15	238	27.3	2.5	2,990	270
	„ 36	235	26.4	2.7	2,880	350
	„ 6	238	26.3	1.3	2,860	140
	„ 1	235	24.4	1.8	2,670	200
	„ Mixture A	240	26.8	1.0	2,910	110
	„ „ B	245	25.6	2.4	2,780	260
Under 7 months	Radin 7	210	22.4	3.4	2,450	370
	„ 4	210	21.3	1.8	2,320	200
	„ 13	185	20.4	2.0	2,240	220
	„ 11	180	19.6	2.5	2,140	270
	„ 2	180	19.2	1.6	2,100	170
	„ Mixture	190	20.3	1.9	2,210	210
	Pahit 1	215	18.8	0.7	2,070	80
	Siam 29	200	20.0	4.4	2,180	480
	Mayang Kuning F.S. 55	200	20.5	1.8	2,250	200
	Milek Puteh F.S. 148	180	16.6	2.5	1,810	270
	Nachin F.S. 756	170	21.2	3.6	2,310	390
	„ F.S. 8	170	16.3	2.0	1,780	220
	Nachin 10	170	21.1	1.7	2,300	190
	„ 48	170	14.9	2.1	1,620	230

In conjunction with the work of this station subsidiary tests of pedigree strains in randomised replicated plots (3 to 8 replications) were established in 8 sub-stations and the best average yields per acre in pounds are shown in table II.

Table II.

Average Yields from Plots of Pedigree Strains.

Locality	Selection	Replications	Yield Lbs. per acre	Straw
Kampong Perak	Nachin F.S. 756	5	2570	Strong
„	Milek 148	5	2290	„
„	Nachin 10	6	2080	Weak
„	Radin 4	6	2060	Strong
Gunong Semanggol	Nachin 10	6	2050	Weak
Kuala Kurau	Seraup 15	6	2260	Strong
Tangjong Piandang	Radin 2	8	1970	Strong
„	Radin 4	8	1910	„
Bagan Serai	Seraup 1	4	1780	„
Bagan Tiang	Seraup 36	3	2430	„
„	Radin 4	3	2270	„
Alor Pongsu	Nachin 10	3	1150	Weak
Selinsing	Radin 2	3	950	Strong
Titi Serong	Nachin F.S. 756	3	2730	„
„	Seraup 15	3	2840	„

The above yields were better than those from unselected padi.

Hybridization. From 1927 to 1930, experiments were conducted with the object of developing and perfecting a technique for cross-pollination of padi, suitable to local conditions.

The F 2, generation of the surviving Radin Nachin "Crosses" from the 1929—30 season's experiments were sown at Titi Serong last season (1931—32).

One of the joint authors who had been conducting these experiments, was on leave during most of the season and only returned just in time for harvest so that a full record of the characters of the segregating types was not possible.

Counts of grain characters were, however, made and showed that white glumes are dominant to straw-colour glumes, longness of grain is dominant to shortness, and broadness to slenderness.

A combination of these characters segregated in numbers approximating to the Mendelian ratios 1, 3, 3, 3, 9, 9, 9, 27, so that there appears to be a simple relationship between each of these pairs of characters.

These plants, the results of technique experiments, are interesting in being the first hybrids, known to have been obtained experimentally, in Malaya which are available for study. Last season, however, 12 new "crosses" were made which aim at combining the most desirable characters of two selected strains.

High yielding but weak strawed Siam 29 and Nachin 10 have been "crossed" with each of the following strong strawed varieties Radin 2, Seraup 36, and Nachin F.S. 27.

The late maturing, heavy yielding Seraup 36 has been "crossed" with the early Serendah F.S. 875 and late maturing, heavy yielding Seraup 15 with early strong strawed Nachin F.S. 27. Siam 29 and Nachin 10 have been "crossed" with each other and with Serendah F.S. 875, and Radin 4 has also been "crossed" with Serendah F.S. 875.

It is hoped that some of these cross-pollinations will produce valuable new strains, particularly those which aim at strengthening the straw of Siam 29 and Nachin 10.

Experiments designed in 1929 to trace the amount of natural cross-pollination which may take place under Krian conditions showed that some types more readily hybridise than others but that on the average, natural cross-pollination did not amount to 1 per cent.

Pulau Gadong Experiment Station, Malacca.

The season under review was a good one from every aspect, rainfall was abundant and well distributed, pests did little damage and the harvest was reaped in dry weather.

Selection work with the chief local varieties, Padi Nachin, Padi Siam, and Padi Radin Siak, was continued on the lines previously adopted. Of the first series of Nachin selections, 6 were tested for yield against local unselected Nachin in randomised plots (.003125 acre in size) in five adjacent blocks. Borer attack, together with a probable soil fertility gradient, caused wide variation between the strains tested.

Statistical examination of yields showed that N. 10 and N. 66 are significantly better than N. 50, N. 67 and the control, while N. 11 is almost similarly superior.

N. 10 displayed its characteristically weak straw. No. 66 is a popular type which does not easily shed its ripe grain and, in common with N. 11, possesses moderately good straw.

TABLE III.

Results of Trials with Strains of Padi Nachin

Variety	Maturation Period days.	Mean Yield grms. per plot.	Mean Yield lbs. per acre.	
Nachin 10	179	3,654	2,598	
„ 66	184	3,628	2,579	
„ 11	184	3,544	2,518	
„ 70	176	3,246	2,307	
„ 50	184	3,116	2,214	
„ Control	186	3,014	2,144	
„ 67	169	2,794	1,987	The signficant difference between mean yields is 472 grammes per plot.

Similarly, 5 Padi Siam selections were tested against a local unselected sample of the same variety with the average results as tabulated below. Siam 29, Sm. 66 and Sm. 18 proved to be significantly better yielders than the unselected padi, while Sm. 29 and Sm. 66 were significantly superior to Sm. 76 and Sm. 72. Under the station conditions Sm. 29 did not yield as heavily as N. 10 in the past season, but it is a more popular eating padi.

TABLE IV.

Results of Trials with Strains of Padi Siam

Variety	Maturation Period days.	Mean Yield grms. per plot.	Mean Yield lbs. per acre.	
Sm. 29	184	3,920	3,110	This trial was laid out in
„ 66	184	3,622	2,875	general randomisation, not
„ 18	192	3,488	2,770	randomised within blocks.
„ 76	176	3,206	2,545	Treated as a completely
„ 72	184	3,228	2,560	randomised block the signi-
„ Control	190	3,848	2,260	ficant difference between mean yields is 604 grms.

It is interesting to note that in the manurial experiment plots all the above strains of Nachin and Siam matured between 20 and 30 days earlier than those periods recorded above.

Ninety-nine rows of a second series of Nachin types were grown in ear-to-row lines for selection purposes. Of these, several show promise, while N. 199 was outstanding in yield per plant, and had good grain and straw characters. Twenty-two strains were selected for further trial. In this series, 35 lines showed heterozygous characters and from these, 45 types were picked out for further investigation next season.

Fifty-five rows, of a similar series of Siam types, were grown, 32 lines showed heterozygous characters and 63 types were isolated from them for further examination. The low proportion of plants which breed true to type is characteristic of Padi Siam in Malacca. Only 9 of the lines which were true to type appeared worthy of further trial in the next season.

In connection with the search for a strong strawed, early ripening, heavy yielding type, 116 ear-to-row lines of padi Radin Siak were grown for the second season and examination of grain, yield and field characters made it possible to discard 65 lines, the remainder being kept for further observation next season. Two lines R.S. 17 (93 grms per plant) and R.S. 24 (100 grms per plant) showed particular promise as good yielders with stout straw; these and 6 more, were deemed worthy of trial next season in "checkerboard" plots.

Nineteen lines of Milek Puteh and 5 lines of Melik Kuning, well known Pahang types, gave yields and show promise under Experimental Station conditions but the field of selection is very limited by such a small number of types. Four of the former and one of the latter types were discarded as possessing undesirable characters. In addition, 7 Titi Serong selections were grown as ear-to-row lines for observation purposes and of these Nachin F.S. 27, originally

selected at Rembau for its earliness and strong straw, and Radin 11, gave good crops and show promise.

Nine multiplication and field observation plots at the Station confirmed the yielding ability of Nachin 10, despite its weak straw, the average yield of all these plots being 2,610 lbs. of grain per acre. Nachin 11 and Nachin 66 with average yields of 3,020 (2 plots) and 2,960 (1 plot) respectively, also yielded highly and seem promising. Siam 29 in 13 plots averaged 2,720 lbs. per acre while Siam 76 (1 plot) with good straw yielded 2,680 lbs. per acre and Siam 18, 66 and 72 produced at the rate of 2,760, 2,520 and 2,960 lbs. per acre respectively, though all three were "lodged" at harvest time owing to weak straw. Titi Serong selections, Nachin F.S. 756 and Serendah F.S. 824, in single plots yielded at the rate of 2,800 and 2,240 lbs. per acre respectively. The very early ripening variety Radin Siak grown in 17 plots, situated on high ground gave an average yield of 334 gantangs (or 1,815 lbs.) per acre, which is quite good under the circumstances.

Talang Experiment Station, Kuala Kangsar.

At this area 9 selected strains were tested against the local padi Radin in randomised, 1/40 acre plots quadruplicated in blocks.

TABLE V.

Results of Varietal Trials at Talang.

Order of Merit	Strain	Maturation period days	Average Yield in lbs.		Order of Merit	Strain	Maturation period days	Average Yield in lbs.	
			per lot	per acre				per plo	per acre
1	Radin 2	180	75.7	3024	6	Radin 13	185	68.8	2752
2	Mayang Ebos 202	170	74.7	2988	7	Nachin F.S. 27	172	68.2	2728
3	„ 208	170	73.4	2936	8	Local Radin	199	66.1	2644
4	Radin 4	184	70.8	2842	9	Mayang Ebos 201*		62.7	2508
5	Mayang Ebos 209	170	69.4	2776	10	Serendah F.S. 741	172	52.7	2108

Significant difference between average yields per plot = 10 lbs.

Radin 2 showed 15 per cent. increase over the control and selected strains Nos. 2, 3 and 4 also showed material increases but in no case were the selections significantly better than the control, though it is doubtful if the control itself was not originally derived from some previously grown, selected strains.

Bukit Merah Experiment Station, Province Wellesley.

During the last season, 11 selected strains were tested against the most popular local variety—Mayang Ebos—in randomised blocks replicated 6 times. The season was an excellent one from every point of view and high average yields were obtained.

* The maturation period of this padi is not given as some of the seedlings came from another Station where seed was sown earlier than at Talang, a record of period would therefore be misleading. The above fact is probably largely the cause of its low yield.

TABLE VI.

Results of Varietal Trials at Bukit Merah.

Strain	Maturation period days	Average Wt. of Grain in lbs.		Strain	Maturation period days	Average Wt. of Grain in lbs.	
		per plot	per acre			per plot	per acre
Seraup 15	218	56.42	2257	Radin 13	175	51.33	2052
Nachin 10	169	56.08	2243	Nachin F.S. 756	140	50.60	2024
Mayang Ebos Local	173	55.67	2226	Seraup 36	219	49.58	1983
Mayang Ebos 205	179	54.92	2196	Mayang Ebos 39	225	45.67	1816
Siam 29	165	53.58	2143	Radin 2	177	44.58	1783
Siam 63	175	52.42	2096	Nachin F.S. 27	169	44.53	1781

Significant difference between average weight = 7.0 lbs. per plot.

Statistical examination of the plot results showed that the variance due to varietal difference was significantly greater than that due to randomisation and that there was no "fertility drift" over the experimental area. None of the strains tested was significantly superior to the local variey Mayang Ebos though Seraup 15 and Nachin 10 gave very slightly better yields and selected Mayang Ebos 205 almost equalled it. Seraup 15, Nachin 10 and Siam 29 were significantly better than Radin 2, Nachin F.S. 27 and Mayang Ebos 39.

Nachin 10 and Siam 29 lodged badly during the dry harvest, while the local Mayang and the selected Mayang Ebos 205 also showed a tendency to lodge. This fault might result in a heavy loss should the harvest occur in wet weather.

Serendah F.S. 824, which was, unfortunately, not included in the varietal test and which gives a very popular eating rice, produced the highest crop in the Test Station for the season.

Mayang Ebos 203, grown in a multiplication plot, also exceeded in yield all the varieties in the varietal trial.

Telok Chengai Experiment Station, Kedah.

Pedigree line selection experiments with the chief varieties of padi cultivated in North Kedah were commenced at this station last season. The varieties of which ears were obtained are Mayang Ebos, Radin Che Nah, Reyong and Radin China—popular main crop, 6 months padis and Kunchor, Chempah Puteh and Chubai—early maturing varieties. Padi Chubai is also a variety cultivated in areas subject to flooding by salt water.

A large number of ears of each variety were selected on appearance in the field. They were subjected to further examination in the laboratory and the following number of ears were reserved for sowing in ear-to-row lines :—

Mayang Ebos	...	100
Rading Che Nah	...	99
Reyong	...	50
Radin China	...	20
Chempah Puteh	...	74
Kunchor	...	30
Chubai	...	30

Ears were sown on 22nd. and 23rd. July, 1931, on floating nursery-beds; seedlings were transplated in the nursery on 5th. and 6th. August and finally transplanted in lines on 19th. to 21st. August.

Growth and vegetative and grain characters were examined during the season, with particular attention to yield of grain, straw strength and early ripening. Some of the lines of Mayang Ebos, Radin Che Nah and Reyong displayed heterozygous characters.

The following number of lines were selected and harvested :—

Mayang Ebos	... 62	Radin China	... 14
Radin Che Nah	... 85	Kunchor	... 4
Reyong	... 24	Chempah Puteh	... 6
		Chubai	... 20

Ears of one plant in each selected line were taken for seed and the ears from the remaining plants were subsequently examined and measured in the laboratory and the weight of grain recorded.

Lines of the 4 main-crop varieties were further recorded in numbers and only those yielding over 7,000 grammes of cleaned grain were reserved for further selection next season and are as follows :—

Mayang Ebos	...	46 lines
Radin Che Nah	...	29 „
Reyong	...	11 „
Radin China	...	10 „

Varietal trials were conducted at four Test Stations and are referred to elsewhere in this summary.

Alor Gajah Test Plot, Malacca.

At this test plot, five varieties of padi Nachin and Siam and one variety of Radin were tested against each other and against local strains of these types. Unfortunately, late sowing of several varieties caused failure through flooding and insect-damage.

Results confirm those obtained at the Pulau Gadong Station, Siam 29 averaging 550 gantangs per acre as compared with 415 gantangs per acre from the local Siam type. Nachin 10 also gave satisfactory results, averaging 50 gantangs per acre more than the local Nachin.

The varietal trial was laid out in six replicated blocks each containing the seven varieties in randomised plots. Siam 29 proved significantly better than both Kampong Siam and Nachin 10, while Nachin 10 proved better than Kampong Nachin. Owing to the late planting and consequent damage, the local Kampong Nachin was significantly better than the selected Nachin 22.

The test plot suffers to a considerable extent from flooding and the difficulty of draining at harvest, but owing to local conditions (system of land-tenure and density of population) it is difficult to acquire any other more satisfactory site.

Kendong Test Plot, Rembau.

This plot was newly opened for the past season and suffered the usual setbacks encountered in starting Test Plots in new areas. The land became available after the season had already commenced so that a late start was made. moreover, many alterations of the small bunds, or banks dividing the plots, were necessary and resulted in bringing raw subsoil to the surface, with consequent detriment to the padi crop. The area was divided into blocks and planted with 12 varieties in 1/40 acre plots with random distribution over each block, but immediately after transplanting and before the plants had become established, a series of floods wrought so much damage that the crops were even more disappointing than was anticipated. A hardwood flume was installed for water conduct, so that the water supply is good and the area should prove quite useful as a Test Plot next season, except for the fact that the subsoil in some of the plots may still be insufficiently weathered. The few sandy plots should only be used for multiplication purposes. The plantings last season included Radin 13, Seraup 36, Siam 29, Mayang Ebos 206, Nachin 10, Radin Siak 10, Nachin F.S. 27, Serendah F.S. 11, local Radin, Radin 2, Serendah F.S. 8, in the order of the crops which they produced, but this order is not indicative of potentialities since damage was irregular throughout the area. Radin 13 and Seraup 36 each produced at the rate of 240 gantangs per acre but all the rest of the varieties failed to exceed 200 gantangs per acre.

Kuang Test Plot, Selangor.

At this Test Plot 9 pedigree selections were tested against the best local variety, known as Padi Rambai Puteh, in randomised 1/40 acre plots replicated 9 times. Shortly after planting, the padi suffered severely from stem borers, necessitating a good deal of replanting which gave the crop a very uneven appearance and greatly prolonged the harvesting period which was wet and led to irregular losses according to type of padi. Grain sucking insects also caused some losses in the early ripening types but rat damage was negligible.

TABLE VII.
Results of Varietal Trials at Kuang

Strain	Maturation period days	Average Yield in lbs.		Strain	Maturation period days	Average Yield in lbs.	
		per plot	per acre			per plot	per acre
Siam 29	220	58.4±13.5	2336	Nachin F.S. 27	184	30.0±5.4	1200
Nachin 10	213	44.7±8.5	1788	Radin Siak 10	172	29.8±5.2	1192
Radin 13	232	33.9±9.9	1356	Seraup 36	264	27.5±11.5	1100
Radin 2	222	33.6±5.5	1344	Seraup 48	267	21.6±5.3	864
Control	239	32.5±8.2	1300	Radin 4	242	18.8±8.2	752

The plots were not randomised within blocks and general randomisation resulted in high standard deviations in yields of all the selections, therefore no significance can be derived from the results. The local cultivators took considerable interest in the work of the station during the season and in the early ripening Nachin F.S. 27 and Radin Siak 10 in particular, and seed of these two selections is in demand.

Kajang Test Plot, Selangor.

Owing to the unsuitability of this area for the conduct of standardised tests only 3 selections (Radin 2, Radin 13 and Nachin F.S. 27) were planted in the last season. Planting operations, also, were seriously delayed by the contractor and the irrigation dam collapsed early in the season so that the young padi suffered severely from drought, and slightly from stem-borers and grain-suckers, while the Radin selections were badly damaged by birds. The results indicated that Radin 13 (2,009 lbs. per acre) gave the best crop but popular opinion favoured Nachin F.S. 27 (1,910 lbs. per acre) on account of its earliness: seed of this selection is in demand for next season.

Dong Padi Test Plot, Raub.

Eleven strains of padi were planted at Dong last season. Of the strains tesed in previous years, 5 strains namely Seraup 15, S. 52, S. 48, Radin 3, and R. 7 were omitted this season. R. 4 being retained in place of R. 7 because R. 7 was not popular for eating in the locality; and 4 strains, namely Siam 29, Nachin 10, Mayang Ebos 210 and Nachin F.S. 27, were included for the first time. Varieties were planted in 1/40 acre plots, and randomised in six blocks.

Planting and all other work was carried out by day labour and was found to be an improvement on the previous system of employing a contractor. Harvesting continued throughout January and February, as some of the short and long term padis were sown at the same time causing ripening at intervals over a fairly long period.

During the flowering period, extremely heavy rains were experienced resulting in "lodging" in some of the plots. In a few cases, previous rat damage had made the padi more liable to lodging.

Crops were, however, better in every respect than those previously recorded at this station. Seraup 36 gave the best yields and Radin 13, R. 4, Serendah F.S. 875 also gave average yields of over 500 gantangs per acre (equilvalent to about 3,000 lbs. per acre).

Radin 2, Siam 29, Nachin 10, Mayang Ebos 210, Nachin F.S. 27, which were sown too early, and the early ripening plots of the local padi Jambak Bawang, suffered damage by pests and heavy rains.

TABLE VIII.

Results Varietal Trials at Dong: Yield figures are in gantangs.*

Strain	Maturation Period days	Mean Yield per 1/40ac. plot	Mean Yield per acre	Significance over local variety
Seraup 36	221	13.66	547	Greater
Radin 13	212	12.74	510	„
Serendah F.S. 875	172	12.73	509	„
Radin 4	213	12.66	507	„
Pahit 1	221	11.17	447	Nil
Siam 29	199	10.54	423	Nil
Mayang Ebos 210	203	10.33	413	Nil
Nachin 10	200	9.83	393	Nil
Nachin F.S. 27	190	9.82	393	Nil
Radin 2	196	9.58	383	Nil
J. Bawang (Local Padi)	218	7.48	299	—

Significant difference between mean yields per plot = 3.78 gantangs.

Variation in plot yields is, in some cases, considerable, due to causes above mentioned, and the significant difference is therefore fairly high.

Four varieties,—Seraup 36, Radin 13, F.S. 875, and Radin 4, however, have given yields significantly greater than that of the local padi Jambak Bawang.

Statistical examination of the results shows that Seraups 36 and 15 are significantly better than the local Seraup variety. Amongst the early ripening types Radin 4, Siam 29 and Radin 2 are significantly better than the local Radin while Radin 7 and F.S. 27 are better but not significantly so. Nachin 10 yielded poorly and may possibly have been unfortunate in the random positioning of its plots, as one plot yielded more than the best of all the controls plots, nevertheless it obviously did not stand the conditions well.

Lenggong Test Plot, Upper Perak.

At this plot, the long maturation period Seraup strains Nos. 1, 15 and 36, were tested against the local Seraup variety (which is possibly derived from Seraup distributions in this neighbourhood about 1919—20.) in randomised plots in 10 blocks. The earlier maturing strains Nachin 10, Siam 29, Radin 2, Radin 4, Nachin F.S. 27 and Radin 7 were likewise tested in 6 randomised blocks against the local Radin variety, which again is possibly derived from previous distributions of selected strains in this area. All varieties showed good, robust growth and high tillering, except in patches where the water was rather deep. Such patches proved to be evenly distributed amongst the varieties. Owing to the heavy crops, heavy rains and strong winds, "lodging" at harvest was common to all varieties in certain places; Nachin 10 was the worst in this respect, while Seraup 36 and Radin 4 appeared to be the most resistant.

*1 gantang = 1 imperial gallon.

TABLE IX.
Results of Varietal Trials at Lenggong

Strain	Maturation period : days	Mean Yield per plot. lbs.	Mean Yield per acre. lbs.	Significance over control.
Seraup 36	217	94.9	3800	Better
„ 15	217	94.0	3770	„
„ 1	217	82.8	3340	Nil
„ Local	217	80.4	3220	
Significant difference between mean yields per plot = 12.6 lbs.				
Radin 4	202	85.9	3630	Better
Siam 29	187	89.5	3580	„
Radin 2	184	88.4	3540	„
„ 7	200	85.4	3420	Nil
Nachin F.S. 27	190	79.0	3160	„
Radin Local	202	67.6	2590	
Nachin 10	187	50 4	2020	„
Significant difference between mean yields per plot = 18.5 lbs.				

Bukit Gantang Test Plot, Taiping.

This plot was used for the first time last season and suffered from several defects common to new areas. Eight selections and one control variety were planted in this area in 4 randomised blocks. Cultivation was delayed by drought but at planting time growing conditions were favourable. The young padi suffered severely from rats, the depredations of wandering cattle, variations in the water supply which led to much trouble from weeds, and from shortage of labour and storage facilities at harvest so that crops were variable but still good under the circumstances, as is shown in the table below.

TABLE X.
Results of Varietal Trials at Bukit Gantang.

Strain	Maturation period days	Mean Yield lbs. per acre	Strain	Maturation period days	Mean Yield lbs. per acre
Radin 4	210	2985	Radin 2	198	1778
Nachin 22	191	2762	Nachin 27	203	2124
Pahit 1	211	2492	Local Radin	195	1702
Radin 7	199	2452	Serendah F.S. 741	199	1233
Radin 13	198	2102			
Significant difference between mean yields per acre = 730 lbs.					

With large variations within the varieties, due to the numerous adverse growth conditions, significance would only be reckoned on differences of 730 lbs., but Radin 4 was significantly better than Nachin F.S. 27, R. 13, R. 2, local Radin.

and Serendah F.S. 741, and Nachin 22, though it lodged badly, was better than Radin 2, local Radin and Serendah F.S. 741.

Many of the adverse circumstances encountered should be remedied next season and thus lead to more precise comparisons in the future in this important area.

Bruas Padi Test Plot, Perak.

This Station was commenced for the first time last season. An area of five acres was selected and a strong batas, or bank, built round it.

Preparation of the land took longer than was expected, as there were many tree stumps to be removed and much levelling to be done.

The 5 acre area is divided into three subdivisions, each being one and two-thirds of an acre; the whole being an accurately measured rectangle, 10 chains by 5 chains.

The following varieties were planted for yield trials in 1/40 acre plots randomised in three blocks, with four replications in each block:—

Serendah F.S. 741, Mayang Ebos 201, Nachin F.S. 27, Radin 2, Radin 4, Radin 7, Radin 13, and local Radin; and Seraup 1, Seraup 36, Seraup 15 and local Seraup.

The land was lower at one end of the Station than the other, and the Seraup strains were planted at this end, so that there are, in effect, two trials, one of Seraups and the other of Radins, each randomised in three blocks.

The Seraups showed good growth, but the growth of Radins and other short term varieties was poor. The area is very patchy, with irregularities in soil and levels. The plots suffered from temporary lack of water in January owing to a broken dam, and later, the plots could not be properly drained on account of various other difficulties. These difficulties being known, it will be possible to guard against them next season.

As was to be expected in newly cleared land, considerable damage was done by pests, chiefly rats and stem-borers.

The local Radin strain gave comparatively excellent yields. The average yield being the highest for the whole experiment and it might be worth making selections, locally, from this.

The Seraup planted in the deeper portion of the area all gave fairly good yields; while the poorest yields amongst the short term varieties were recorded for R. 4 and R. 7 whose maturation periods are slightly longer than those of the other Radins; being planted in the higher portion they were consequently more affected by the shortage of water in January.

Table XI.

Results of Varietal Trials at Bruas.

Strain	Maturation period days.	Mean yield per 1/40 ac. plot in lbs.	Mean yield per acre in lbs.	Significance
Local Radin	177	55.9	2236	
Mayang Ebos 201	206	46.5	1860	Less than control
Radin 2	201	42.0	1680	" " "
Serendah F.S. 741	198	40.3	1612	" " "
Nachin F.S. 27	197	36.2	1448	" " "
Radin 13	205	34.5	1380	" " "
Radin 7	210	27.8	1112	" " "
Radin 4	210	26.1	1044	" " "
Significant difference between mean yields per plot = 6.34 lbs.				
Seraup 36	223	53.71	2148	Nil
Seraup 15	221	51.67	2067	"
Local Seraup	230	48.29	1932	—
Seraup 1	224	47.10	1884	Nil
Significant difference between mean yields per plot = 7.80 lbs.				

In Batu Kurau Mukim near Taiping, a compilation of results derived from the distribution of selected seed, showed that Seraup 36, which is well established in the mukim, still produces very satisfactory crops, since, of 28 measurements, 24 showed substantial increases over the crops derived from local, unselected padi.

Glugor Test Plot, Penang.

At the Glugor Test Plot in Penang, the past season was ideal as far as weather conditions were concerned and in consequence, growth was robust and tillering good. Rats, however, were very destructive, and some stem borer damage also occurred. At this Test Plot, 9 selected strains of padi were tested for yield against the best, local popular variety (Sekapoy) as a control, and each variety was planted in 6 randomised blocks. Water control, which has been greatly improved on this area, was excellent throughout the season.

Rat damage was, however, very severe in nearly all the early planted plots of late maturing types and was variable in the later planted plots of varieties of shorter maturation periods, so that results are not truly comparable and will not be given, but fair average crops were harvested from Radin 4, R. 13, R. 2, Siam 29 and from the two early ripening types Radin Siak and Nachin F.S. 27 which both showed strong straw characters.

In order to test the possibility of obtaining two crops of early maturing varieties of padi from the same land within twelve months, as a method of increasing local production of padi, "double-cropping" experiments were started at this station on suitable land, that is, where control of water supply and drainage is as satisfactory as possible.

In 1930 in the normal padi season a good crop of each variety tried was obtained, the inter-season crop was, however, damaged by floods and had not matured when it was time to prepare the land again for the next season. The plants were, therefore, cut down and this season's crop was planted immediately.

Six varieties and strains were tried, in duplicate plots.

The season was a good one and yields obtained were satisfactory.

TABLE XII.
Results from Varietal Trials at Glugor.

Strain	days Maturation period :	Yield per acre Calculated average in lbs.
Siam 29	199	2,430
Radin 2	208	2,220
Serendah 824	198	2,070
Nachin F.S. 27	192	1,980
Radin Siak F.S. 10	184	1,970
Nachin 10	202	1,960

Siam 29 and Radin 2 gave the best crops, but these varieties having over six month maturation periods, under Glugor conditions, would require that the second crop nurseries should be prepared in advance of harvesting of the first crop to allow time for harvesting and preparation of land between crops.

Radin Siak has a shorter maturation period than the remainder and has strong straw, this may prove to be the most satisfactory variety.

The inter-season crop, planted in March, was again a failure owing to flood damage, in spite of improvement in the drainage facilities.

Test Plots in Kedah.

In conjunction with the work of the Teluk Chengai Experiment Station, four temporary test plots, distributed in representative padi areas, were planted last season with selected strains and local popular varieties were used as standards for comparison.

Land, in each case, was merely rented in order to gauge its value for use before permanently designating it as a Test Plot. Tests were made in replicated plots of 44 x 22 feet in each area.

Jitra.

This area comprised 3.3 acres and had the advantage of irrigation water which is led by a canal from a dam in the Jitra river : though this was counterbalanced by the depredations of land crabs. Three selections were tested against the average of three local popular varieties in 5 "chess boarded" replications.

Nachin 10, with an average yield of 3,100 lbs. per acre was found to be significantly better than the controls.

Langgar.

This station contained 2.4 acres. Three selections were tested against the average of 3 local popular types. Again Nachin 10 with a yield of 2,394 lbs. per acre proved to be significantly better than the other types, while Siam 29, just out-yielded the controls, which averaged 1,964 lbs. per acre. In this locality Siam 29 was favoured as an eating rice more than Nachin 10 which was not considered to be very palatable.

Sala Kanan.

This area of 2.1 acres is irrigated by a dam in the drainage canal, it is representative of recently cleared "gelam" land* and was prepared for planting by the "tajak"†. Three late maturing selections were tried against the local popular variety, Mayang Ebos, in 5 "chess boarded" replications. Seraup 15 gave a yield (2,413 lbs. per acre) significantly better than the controls (2,022 lbs.).

Rantau Panjang.

The area of this station is 3.5 acres. Very adverse conditions, (flooding drought, and pests) rendered results of no value, although there were indications that the local varieties produced better crops than the three selections which were planted. (Radin Strains nos. 2, 4 and 13).

TABLE XIII.

Results of Varietal Trials on Test Plots in Kedah

Test Plot	Strain	Maturation period : days	Average Yields in lbs.		Significance over Control
			Per Plot	Per Acre	
Jitra	Nachin 10	188	68.5	3,100	Better
	Radin 2	188	50.6	2,268	Poorer
	Radin 13	188	51.1	2,289	Nil
	Controls	188	54.2	2,444	
Significant difference between average weights per plot = 3.5 lbs.					
Langgar	Nachin 10	188	53.3	2,394	Better
	Siam 29	185	43.9	1,989	Nil
	Radin 2	183	40.0	1,792	Poorer
	Controls	183	43.5	1,964	
Significant difference between average weights per plot = 3.0 lbs.					
Sala Kanan	Seraup 36	213	58.6	2,629	Nil
	Seraup 15	221	54.4	2,413	Nil
	Radin 7	200	57.1	2,545	Better
	Controls	209	45.1	2,022	
Significant difference between average weights per plot = 10.1 lbs. (for Seraup 36 = 15.9 lbs.)					

* Secondary jungle land on which a preponderance of *Melaleuca leucadendron*, or the Kajeput oil tree, is found.

† An instrument somewhat resembling a short, heavy bladed scythe, used for cutting down weeds at ground level.

Though Nachin 10 and Siam 29 suffer from the defect of weak straw, the dry harvest counteracted this fault and little loss of grain was sustained. The harvest in Kedah is usually dry, but even so, these types of padi should improve in value if their straws can be strengthened by crossing with suitable varieties. At each of the Test Plots where crops matured under normal conditions, at least one selected type of padi was found to be significantly superior to the best local, popular varieties, while at Sala Kanan, all three tested selections gave materially better crops than the controls. Consequently a demand for selected seed has developed in the neighbourhood of these plots and much interest is shown in the tests.

Perlis Test Plots.

Two Test Plots (Arau and Sanglang) were planted in the past season and the results indicated better yields from one of the local unselected varieties as shown in the summary below :

TABLE XIV.
Results from Trials with Padi Radin and Local Strains in Perlis.

Strain	Average Yields in Gantangs		Approx. Equivalent in lbs.
	Per Plot	Per Acre	
Radin 13	9.25	405	2,400
Radin 2	8.50	383	2,250
Radin 4	8.25	371	2,200
Reyong	10.50	473	2,800
Kunchor	8.50	383	2,250

Part II.

MANURING

BY

W. N. C. Belgrave,

Chief Research Officer.

Manurial trials were continued at Titi Serong, Pulau Gadong and Talang and in addition were carried out at Bukit Merah and Telok Chengai.

Telok Chengai, Kedah.

The lay-out on this station followed that described for the Federated Malay States and Straits Settlements Stations for the season 1930-31; there were eleven treatments which, like the controls, were replicated 6 times, arranged in 6 half-blocks grouped into 3 blocks. Two pedigree strains Radin 2 and Radin 13 were grown.

The area consisted of nearly level clay alluvium which had been under continuous cultivation with padi for many years. It was not irrigated, the crop being dependent on rainfall, of which there was 56 inches from July to December. Except after heavy rain there was little water movement. In the previous season the trial area, like the rest of the station, received a dressing of Kedah bat-guano (containing 17 per cent. P_2O_5) at the rate of 1,000 lbs. per acre, but no manure had been applied for several years previously and the padi straw had been burnt off each season after harvest.

Plots were 1/45 acre (1/32 relong) in area with sufficient border space to eliminate bund effect. The land was prepared for planting by local methods *i.e.* it was ploughed, harrowed and rolled in a wet condition, the operation of harrowing being repeated until all grass and weed growth had disappeared.

Seeds were sown in a wet nursery on July 18th. Manures were applied on September 1st, transplanting done on September 7th and the plots flooded to a depth which did not exceed 2 inches. 3—4 plants per hill were planted, spaced roughly at 14 x 18 inches. By September 12th, the depth of water had reached 6 inches. At the end of October, vegetative growth exhibited striking differences, plots with nitrogen and phosphorous from artificials were mostly good, while the control plots and those treated with potash were definitely poor. Growth on the other plots showed considerable variation.

Flowering was general by December 12th and water was gradually drained off after this date. Harvesting was commenced on January 24th and completed on January 27th.

A few plots were damaged by storm and have been excluded.

Recording of yields was by weight; the volume yields given below have been calculated from the specific gravity of bulked samples. For convenience of comparison with stations in the Federated Malay States and Straits Settlements, yields have been recalculated to 1/40 acres.

There were no significant differences between the yields of the two strains, nor in the results from identical quantities of Nitrogen and Phosphorous applied as ammonium sulphate and superphosphate, or as "ammonium phosphate"—these have therefore been taken together in the following table.

The numbering of treatments follows that of last year's trials.

TABLE I.

Results of Manurial Experiments at Telok Chengai, Kedah.

Treatment	Manure	Quantity per acre of Nutrients lbs. N.	P_2O_5	Lbs. per 1/40 ac.	Gantangs per acre	Average No. of Tillers at harvest
I	Ammonium phosphate or sulphate of ammonia and super-phosphate	12	15	57.5*	405	17
II	„	25	30	63.0†	440	18
III	„	12	41	63.2	445	17
IV	„	24	82	62.9	440	18
V	„	6	37	62.7	440	17
VI	„	12	73	66.1	465	18
VII	„ + potasium sulphate	12	41+19K_2O	55.0†	385	16
VIII	„ + Kainit	12	41+70K_2O+ 35MgO	60.6	425	16
IX	Kedah phosphate	0	30	55.0	385	16
X	„ „	0	60	62.7	440	17
XI	„ „ + Am. sulphate	12	30	62.5†	440	16
XII	Control			56.2	390	16

The minimum differences between the means of any pairs of treatments for 'significance' of P = .05‡ are 5.5 lbs. in the case of a treatment of 5 or 6 replicates compared with one of 6 replicates and 6.7 lbs. in the case of 4 or 5 replicates compared with 5.

On this basis all treatments except I, VII, VIII and IX, have given 'significant' increases while the effect of potash in VII has been to neutralise the good effects of N/P in III. The addition of magnesium salts appears partly to overcome the ill effects of potash.

It would appear from the fact that treatment X gives increases, while treatments I and IX do not, that the main limiting factor is phosphorous, which must exceed a limiting concentration before increases can be obtained. The heavy, basal dressing of phosphate given a year ago, has to be borne in mind as without it there is a probability that the control plots would have been poorer, and greater increases on those manured have been shown.

* Two plots discarded. † One plot discarded.

‡ 'Significance' of P = .05 is a short method of expressing the mathematical fact that the odds are 20 to 1 against the attainment of the given value or values by chance, *i.e.* there is a considerable measure of certainty that manuring has been responsible for the increase found.

Separate experiments gave no significant differences for chelluped* over non-chelluped plots.

Bukit Merah Province Wellesley.

The experiments were carried out at the Departmental Experimental Station at Bukit Merah and were laid in a modified Latin Square with four replications consisting of a double row of plots thus :—

B D C A C A B D
A B D C D C A B

Plots were of an area sufficient to give a reaped portion 1/40 acre in extent, with a border to eliminate bund effect. Weeds were first cleared in the middle of June—ploughing commenced on 24th June and was followed by a second ploughing, raking and rolling after a month's drought.

Seed was sown on 26th July and transplanted on 3rd September. Flowering started on 8th January and reaping on 22nd February. Weather conditions during the growing season were ideal.

TABLE II.

Results of Manurial Experiments at Bukit Merah.

	Lbs. per 1/40 ac.	Gantangs per ac.	Average No. of Tillers.
A. Nursery manuring with mm. phosphate 300 lbs. p.a. ...	51.6	352	21
B. Chellupping with bone meal ...	52.0	361	20
C. Field manuring am. phosphate 100 lbs. p.a. ...	57.3	395	22
D. Control ...	47.1	328	20

Pedigree strain S.K. 36 was employed.

The figure for increase over control (significance P = .05) is 2.6 lbs. or 15 gantangs and for difference in either direction 3.2 lbs. or 18 gantangs.

The arrangement adopted gave very considerably enhanced accuracy in this case, although theoretically it is not ideal.

All treatments are thus seen to have been significant.

Titi Serong (Krian, Perak) Talang (Kuala Kangsar, Perak) & Pulau Gadong (Malacca.)

The experiments were on the same areas as those of the previous season and arrangements were made to ascertain whether there was residual effect. There were replications of each treatment arranged in blocks; "treatments" I—VI were so arranged that they included two replications each of last season's treatments Nos. I—III, V, VI and VII, which at that time gave no significant differences among themselves. Treatments VII—XII were on last season's plots, VII—IX having this year repeat additions of manure, and VI. X—XII having no manure this year; X was the control in both seasons. By comparing this season's yields from treatments I—V with VI, XI and XII, the effect of the

*'Chelluping' is the practice prevalent in Malacca of dipping the roots of seedlings at the time of transplanting in a paste of bone meal and water.

new treatments on land manured last season may be obtained, by comparing XI and XII with X, residual effect from last season may be obtained.

Seasonal dates and kind of padi used were as follows :—

		Titi Serong	*Talang*	*Pulau Gadong.*
Sowing of seed	...	10. 8.31	23.8.31	22.6.31
Transplanting to field	...	17.10.31	27.9.31	5.8.31
Flowering	...	1. 1.32	5.1.32	?
Harvesting	...	17. 2.32	13.2.32	16.1.32
Kind of padi	...	Radin 2	Radin 2	Siam 29

TABLE III.

Results of Manurial Experiments at Titi Serong.

Treatment	1931—32 Yield			1930—31	
	Lbs. per 1/40 ac.	Gantangs per acre*	Average Tillers at harvest	Treatment	Gts. per acre
I Nursery manuring at the rate of N 39 lbs. P_2O_5 144 lbs. per acre with ammonium phosphate	43	300	12	Various manurial mixtures	379
II Nursery as in I and field manuring P_2O_5 35 lbs. per acre with superphosphate	42	290	11		
III Chellupping with bone meal	45	310	11		
IV Cyanamide and basic slag N 12 lbs. P_2O_5 40 lbs.	49	340	11		
V Ammonium phosphate, kainit lime=N 13 lbs. P_2O_5 48 lbs. K_2O MgO CaO 70 lbs.	45	310	12		
VI No manure	54	370	12		
VII Ammonium phosphate N 24 lbs. P_2O_5 82 lbs.	47	320	12	same	250
VIII Ammonium sulphate and superphosphate N 12 lbs., P_2O_5 73 lbs.	43	290	12	same	334
IX Perlis phosphate = 92 lbs. P_2O_5	41	280	12	same	330
X Control	48	330	11		365
XI No manure	—	—	Perlis phosphate = 46 lbs. P_2O_5		366
XII No manure	—	—	Perlis phosphate and ammonium sulphate N 121 lbs., P_2O_5 46 lbs.		

Calculated from weights.

There has clearly been no response to manuring, nor has there been any residual effect.

Owing to a misunderstanding, results from "treatments" XI and XII could not be obtained; in their place was tried a mixture of wood ashes 40 lbs. ammonium sulphate 40 lbs. fish guano 100 lbs. superphosphate which gave a yield of 44 lbs. per 1/40 acre or 300 gantangs per acre.

Talang.

The experimental area was submerged for some days during the considerable floods of December and the most forward plots (those which had received nursery treatments) suffered to some extent.

A number of plots were attacked by bena puteh (*Sogata furcifera*) but this did not appear seriously to affect the yield.

TABLE IV.

Results of Manurial Experiments at Talang.

Treatment	Yield 1931—1932			Yield 1930—31
	Lbs. per 1/40 ac.	Gantangs per acre	Average Tillers at harvest	Gantangs per acre
I Nursery manuring at the rate of N 39 lbs. P_2O_5 144 lbs. per acre with ammonium phosphate	52	378	12	
II Nursery as in I and field manuring P_2O_5 35 lbs. per acre with superphosphate	53	352	14	
III Chellupping with bone meal	56	407	18	389
IV Cyanamide and basic slag N 12 lbs. P_2O_5 40 lbs.	63	442	14	
V Ammonium phosphate, kainit lime=N 13 lbs., P_2O_5 48 lbs. K_2O MgO CaO 70 lbs.	66	458	16	
VI No manure	54	371	14	
VII Ammonium phosphate N 24 lbs. P_2O_5 82 lbs.	73	509	18	486
VIII Ammonium sulphate and superphosphate N 12 lbs., P_2O_5 73 lbs.	70	476	16	419
IX Perlis phosphate = 92 lbs. P_2O_5	73	508	15	408
X Control	44	332	12	247
XI No manure	63	466	15	326
XII No manure	58	423	14	407

Significant increases over a control for P = .05 are 6.4 lbs. or 44 gantangs*; and for differences in either direction 7.7 lbs. = 53 gantangs.*

Comparing VI, XI and XII with X it is clear that last season's applications have had a marked positive effect this season; comparing IV and V, VII—IX with VI, there has been a significant, but not invariably large, increase as a result of this season's application. Neither the basic, nor the complete mixtures IV and V, have produced larger increases than VII to IX, but it must be remembered that the yields of the three latter treatments were higher last season than the mean of those on which IV and V are superimposed.

Owing to flood damage it was impossible to judge the effects of nursery treatments.

Pulau Gadong.

The weather throughout was satisfactory. Some of the manurial plots were attacked by stem borer which slightly reduced the yields; others in block C were badly attacked by rats—the former have been included the latter excluded, from the following table :—

TABLE V.

Results of Manuring Experiments at Pulau Gadong.

Treatment	Yield 1931—1932			Yield 1930—31
	Lbs. per 1/40 ac.	Gantangs per acre	Average Tillers at Harvest	Gantangs per acre
I Nursery manuring at the rate of N 39 lbs. P_2O_5 144 lbs.	65	460	19	
II Nursery as in I and field manuring P_2O_5 35 lbs. per acre with superphosphate	65	470	19	
III Chellupping with Perlis phosphate	69	500	18	355
IV Cyanamide and basic slag N 12 lbs. P_2O_5 40 lbs.	62	460	17	
V Ammonium phosphate, kainit, lime = N 13 lbs. P_2O_5 48 lbs. K_2O MgO CaO 70 lbs.	59	430	15	
VI No manure	64	460	18	
VII Ammonium phosphate N 24 lbs. P_2O_5 82 lbs.	63	460	18	315
VIII Ammonium sulphate and superphosphate N 12 lbs., P_2O_5 73 lbs.	65	450	19	352
IX Perlis phosphate = 92 lbs. P_2O_5	65	480	18	373
X Control	60	410	17	323
XI No manure	61	450	18	324
XII No manure	61	440	16	340

* Calculated from yield in lbs.

Differences which would have significance P = .05 are for an increase over a control 4.8 lbs. or 33 gantangs* or in either direction 6.1 lbs. or 43 gantangs.*

The striking discrepancy between the weight and measure of the control (X) is probably another illustration of the difficulty of measuring accurately small quantities of padi.

Taking weights as the more accurate measurements and comparing VI, XI and XII with X, no residual effects appear; comparing I to V with VI, there is a possibility that chellupping has effected some improvement.

Summary of Results.

These are very similar to those of last year and tend to show that each station, for a particular season, has a maximum beyond which manuring with artificial fertilisers cannot increase the crop. Where, as in Kedah, Province Wellesley and Malacca, this maximum is comparatively near to the normal yield, small increases are obtained; where it is far above the normal, as at Talang, large increases are obtained.

No deductions can be drawn from results at Titi Serong as there was a complete absence of response.

Taking the value of one gantang of padi at 10 cents we have :—

	Telok Chengai	Bukit Merah	Talang	Pulau Gadong
Increase over control — gantangs per acre	± 50	± 60	± 130	± 35
Increased monetary return $† per acre	5	6	13	3.50

Since the cheapest field dressing (400 lbs. per acre) of Perlis phosphate costs approximately $4/-, it is clear that only at Talang could manuring be recommended for a monetary return in one season—which is the only type of return likely to appeal to cultivators unaccustomed to manuring; actually, it must be remembered that Telok Chengai had received in the previous season a large, basal dressing of phosphatic fertiliser which may have obscured response.

While residual effect is marked at Talang it is absent on a commercial scale at Malacca.

There remains the question of cheaper forms of manuring, such as nursery application or chellupping—in Kedah chellupping had no effect, in Malacca it gave an enhanced yield just on the borders of significance; at Talang and at Bukit Merah positive increases were obtained and the former would probably have been higher in the absence of flood damage. Nursery manuring was less beneficial.

These results shed no light whatever on the reason or reasons for the existence of the "bar". Reference to Table III page 613 shows that the soil at Talang is richer in nutrients than at Pulau Gadong or at Titi Serong and, it might be argued, that there alone is the general level of plant food sufficiently high to

* Calculated from yield in lbs. † $1 = 2s. 4d.

permit the relatively small quantity of some one nutrient added as manure to have any effect. This view is, however, rendered difficult of acceptance by the fact that it is precisely at Talang that the controls have for two seasons exhibited the smallest values.

The remarkably low tillering at Titi Serong and Talang does not help in the search for an explanation since at the former, response to manuring is poor and at the latter, high.

Correlations were worked out between manuring, tillering and yield for Kedah and it was found that while there was some positive correlation between manuring and tillers, there was none between tillering and yield—in other words increases have occurred in both tillering and yield but without causal connection. Inspection of the tables for other stations leads to similar conclusions.

Manurial Experiments 1932-1933.

Whatever the cause, it seems useless to continue on orthodox lines—previous experiments and those of the last two seasons all show that no increase beyond the "bar" will be obtained by such methods. We have now to enquire whether manures will aid the soil (if aid is needed) in supporting more plants per unit area, i.e. to test the possibility of obtaining greatly increased yields by manuring and closer planting. There is the greater possibility of this as in Italy, yields of 800 gantangs per acre are obtained with planting distances of 8 ins. x 8 ins.

It is fortunate that examination of the results of subdivided 1/40 acre plots has shown that experimental error is not greatly increased by reduction of area to 1/120 acre and thus the proposed complex experiment may be carried out without increasing necessary area or labour.

It is proposed to test (*a*) chellupping, (*b*) phosphorus, (*c*) nitrogen and phosphorus and (*d*) control with 3 planting distances—arranging the manurial treatments in 1/40 acre plots with 4 replications in a Latin Square and subdividing the plots into three sub-plots of different planting distances of 1/120 acre each. The greatest planting distance and number of plants to a hole will be that current in the district and the other two distances should be 3 ins. x 3 ins. and 6 ins. x 6 ins. less than this.

A small subsidiary experiment to test the effect of cattle manure and of very large applications of artificial nitrogenous fertilisers has also been laid down.

Part III.

EXPERIMENTAL ERROR OF FIELD TRIALS

BY

W. N. C. Belgrave,

Chief Research Officer.

The standard area harvested in padi experiments in Malaya has been in the past 1/40th acre. This necessitates provision of considerable areas for experimentation when due allowance is made for minimum breadth of 6 feet around each harvested portion. Steps were taken last season to ascertain whether smaller areas, comparable with those employed in Ceylon, would not suffice. The central 1/40th acre portion of the control plots in the manurial experiments described in Part II of this article, together with similar plots on the Padi Test Stations at Dong in Pahang, Selinsing and Lenggong in Perak, were divided at harvest into nine equal sub-plots of 1/360th acres in extent, and the yield of padi separately recorded from each sub-plot (with the exception of Telok Changai where the 1/45th acre plots employed were divided into eight sub-plots). It is fully realised that the experimental error of sub-plots so found is not exactly comparable with the 1/40th acre plots since the latter are provided with bunds and slight differences of water supply might considerably increase experimental error. On the other hand, consideration of the error of varietal trials where separate bunds are not invariably provided, does not suggest that this disturbing factor is large.

Sub-plots were numbered 1, 2, 3 and the yields have been combined and

4, 5, 6

7, 8, 9

statistically treated in different ways—three sub-plots of 1/120th acre and one of 1/90th acre to each plot have been obtained by combining (*a*) 1/360th acre yields into three rows or columns (whichever gave the *greater* variation in order to provide as rigorous a test as possible) and (*b*) the four yields of sub-plots No. 1, 2, 4, 5.

Sub-plots at Telok Chengai were numbered 1 2

3 4

5 6

7 8

and were combined either 1, 2, 3, 4 etc. or 1 2 3 4, 5 6 7 8.

The sub-plots or their combinations were also treated as (*a*) completely randomised, (*b*) restricted in blocks (*c*) in the case of the 1/360th acre results, arranged in Latin squares.

The usual number of replications of 1/40th acre plots was six.

Standard deviations expressed as percentages of yield are given below and show that on the whole it is justifiable to expect that no great degree of accuracy

would be lost by reducing the size of plots to 1/90th acre completely randomised, 1/120th acre restricted in blocks or 1/360 in Latin squares. (Table I).

The unit for the general manurial experiments described in Part II for the season 1932—33 has been taken as 1/120th acre and results will confirm or disprove the suitability of plots of this size for experimental work in Malaya. Although it would appear possible to employ plots of 1/360 acre, this has not been done as results might completely be spoilt by slight and possibly unnoticed, insect or rat damage.

Details of yields and the statistical working for one station are given in Table I.

Table I.

Pulau Gadong.

Yields in Kilos. of 1/360 acre sub-plots.

Plot I.	2.98	3.08	3.00	II.	3.11	2.90	3.28
	2.78	3.20	3.38		3.90	3.41	3.69
	3.50	3.28	3.38		3.94	3.25	3.25
III.	3.12	3.01	3.17	VI.	2.77	2.83	3.08
	3.47	3.01	3.25		2.98	2.38	2.66
	3.73	3.15	3.30		2.44	2.36	2.77
V.	3.19	3.05	3.19	IV.	2.83	3.24	2.98
	3.72	3.22	3.09		2.69	2.80	3.03
	3.37	3.09	2.76		2.64	2.61	2.68

Completely Randomised	*1/360 acre*	*1/120 acre*	*1/90 acre*	*1/40 acre*
Sum squares ...	6.5484	13.9482	4.3189	28.3662
Degrees of Freedom ..	53	17	5	5
Variance ...	0.124	0.821	0.864	5.675
Standard Deviation ...	0.351	0.906	0.929	2.38
Mean ...	3.08	9.24	12.28	27.72
S.D. as percentage of mean ...	11.4	9.8	7.6	8.7

Taken in Blocks	*1/360 acre*	*1/120 acre*
Sum squares ...	3.3966	4.4928
Degrees of Freedom ...	48	12
Varience ..	0.0708	0.374
Standard Deviation ...	0.264	0.611
S.D. as percentage of mean ...	8.6	6.6

1/360 acre taken in Latin squares.

	Sum of Squares	Degrees of Freedom	Variance	Standard Deviation
Total within Blocks ..	3.3966	48		
Rows ...	1.4976	12		
Columns ..	1.1322	12		
Residue ...	0.7668	24	0.0319	0.178

Standard deviation as percentage of mean = 5.8 per cent.

Table II.

Standard deviations expressed as percentages of means.

Station	*Randomised* 1/360	1/120	1/90	1/40 acre	*Taken in Blocks* 1/360	1/120 acre	*Taken in Latin Squares* 1/360 acre
Pulau Gadong ...	11.4	9.8	7.6	8.7	8.6	6.6	5.8
Bukit Merah ...	11.2	8.0	6.5	6.2	9.9	6.5	7.1
Titi Serong ...	15.8	13.4	7.4	11.1	12.7	10.0	9.1
Talang (Unmanured)	18.3	10.2	11.4	6.7	18.1	9.3	12.5
„ (Manured) ...	21.8	19.1	10.5	13.3	16.6	13.4	12.6
Dong ...	12.0	7.5	5.5	3.6	12.2	8.1	12.4
Selinsing ...	21.3	16.5	14.1	11.8	18.9	13.6	14.9
Lenggong Radin	18.9	16.1	16.5	9.0	17.1	16.9	11.1
„ Seraup ..	17.8	15.1	18.5	15.2	13.2	8.7	14.1

Kedah ...	1/360	1/180	1/90	1/45 acre	1/360	1/180	1/90 acre
	10.5	7.6	7.0	6.4	9.2	5.5	4.4

Part IV.

EXPERIMENTAL PADI TANKS

BY

W. N. C. Belgrave,

Chief Research Officer.

In view of the necessity for rigidly controlled conditions in the study of many problems affecting the padi plant, a series of 50 tanks was constructed at the Government Experiment Plantation, Serdang, in 1929. Tanks are 6 feet x 4 feet x 2 feet 6 inches deep built with bricks, faced with Portland cement and sunk in the ground at a depth of 2 inches. Each tank is provided with water supply, is capable of separate regulation and with an overflow pipe by which the level of standing water can be regulated. At the bottom of each tank is a drain pipe communicating with an outflow provided with a tap so that when and if necessary the effects of percolation as opposed to surface drainage may be studied. The tanks are enclosed in a cage of $\frac{3}{4}$ inch mesh wire netting to exclude birds and rats. Construction of the installation was supervised by Mr. T. D. Marsh, Assistant Agriculturist.

For the first crop of padi the tanks were filled with a clay loam of quartzite formation taken from a cleared hillside, as it was desired to ascertain the requirements for conversion of ordinary inland soils into good padi land. The soil, although light in texture in comparison with the familiar Krian clay, is, nevertheless, representative of many padi areas.

The first crop was a complete failure, even in tanks which had received liberal applications of artificial fertilisers; seedlings grew well but shortly after transplanting they became yellow, the leaves shrivelled and the plants died. Considerable algal film was formed on the surface of the water.

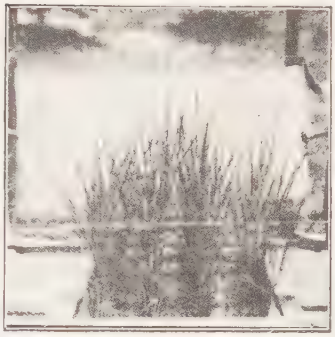
The second attempt in 1930 met with failure, although the plants survived rather longer, and it was then considered that the possible low content of organic matter in the soil might account for the poor growth. Accordingly, the tanks were divided into three series; in the first *Crotalaria anagyroides* was planted; in the second *Mikania scandens* while the third was left bare. Meanwhile three tanks were filled with padi soil brought from Krian and produced an excellent crop of padi, thus proving that failure of the earlier attempts was not due to some inherent defect in the technique but rather to some deficiency in the soil employed. In the early part of 1932 a third attempt to grow a crop of padi was made. Each of the three series of tanks was divided into groups to which the following treatments were applied :—

(*a*) Nothing.

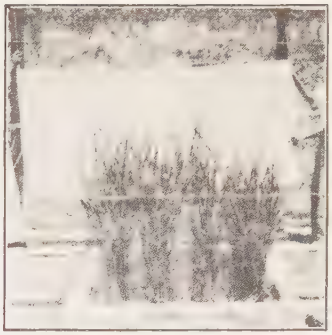
(*b*) Sulphate of ammonia and basic slag at the rate of 100 and 150 lbs. respectively per acre.

CROTALARIA

Control

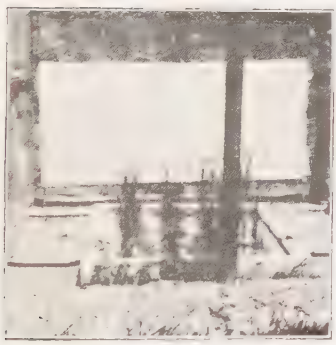


Artificial



Cattle

MIKANIA



Control

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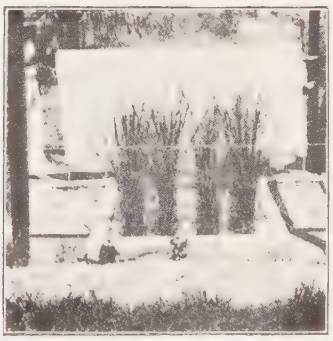
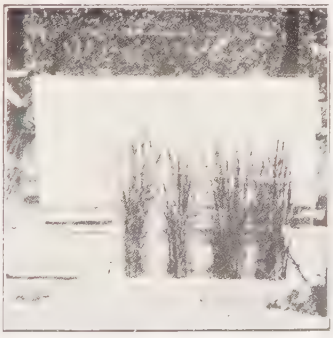


Cattle

NO COVER

Control



Artificial

Cattle

(*c*) As in (*b*) with the addition of cattle manure at the rate of 4 tons per acre.

(*d*) Krian padi soil 20 lbs. per tank.

The object of applying Krian soil was to supply possibly lacking elements of the bacterial flora.

The green matter grown in the tanks was turned in and all treatments, except ammonium sulphate, were given three weeks before transplanting, ammonium sulphate was added two weeks later.

Shortly after transplanting, differences in growth manifested themselves between the different groups and treatments which persisted throughout; in the best tanks there was excellent setting of seed and every prospect of a good harvest. Unfortunately the harvest was lost owing to a severe attack of insect pests, a frequent penalty for growing small isolated patches of grain crops. The results could therefore be judged only by appearance; at intervals throughout the growing period the plants were classified by eye. An example follows.

Classification of growth and appearance taken three months after transplanting Padi in Tanks receiving different Manurial Treatments.

	very poor	poor	medium	good	very good
Crotalaria					
Control ...		1	2		
Artificials ...				1	2
Cattle ...				1	2
Krian ...				2	1
Mikania					
Control ...	2	1	2	1	1
Artificials ...				3	1
Cattle ...				3	
Krian ...		1	2		
Bare					
Control ...	4				
Artificials ...			3	2	
Cattle ...	4			2	1
Krian ...					

This classification is, of course, valid only for this particular experiment and in fact "good" here was equal to "fair" in an average field and "very good" to "good". Plate I, showing the padi just after ear formation, gives a general idea of growth.

The nitrogen content of the Crotolaria when turned in, was approximately 3 per cent. and that of Mikania only 1 per cent. and it is clear that the crop which was richer in nitrogen has been more effective than the poorer one and that both have given better results than with no green matter at all. The interaction between green matter and manure is striking; manure did well in every case but clearly exercised maximum effect only in the presence of Crotolaria.

These experiments indicate the desirability of turning in quantities of green matter as an aid to the rapid "conditioning" of new land for rice growing, more especially if that land has not previously been flooded for long periods. There remains the question of the best time of turning in and of the possible inter-relationships between manure and green matter on established padi fields.

Previously, departmental work showed no increase of yield following the incorporation of excess green matter, with or without fertiliser, in old padi fields but it is possible that the green matter was turned in too early (cf. recent work in Ceylon). Further experiments with the tanks to determine the best time of incorporation are in progress.

Abstract.

TWELFTH REPORT ON NATIVE RUBBER CULTIVATION.

Third Qurater 1932.

Prepared by the Bureau of Agricultural Economics of the Division of Agriculture of the Netherlands Indian Department of Agriculture, Industry and Commerce, at Buitenzorg, Java, November, 21, 1932.

The general advance in prices is noted, the reason assigned for this improvement being (*a*) the heavy consumption of rubber in the United States during June; (*b*) the increasing consumption of rubber in countries other than the United States; (*c*) the slowly decreasing exports from the producing countries; (*d*) the discovery of errors in estimating world stocks, which resulted in stocks being lower than was believed to be the case; (*e*) the general spirit of optimism engendered by the international conferences at Lausanne and Geneva.

This substantial improvement in prices has resulted in increased production and exports of native rubber in Netherlands India.

The total exports of native rubber (dry equivalent) from the Outer Provinces to foreign countries for the first three quarters of 1932 in metric tons were as follows:—first quarter 15,942, second quarter 10,613, third quarter 14,432, a total of 40,987 tons as compared with corresponding figures for 1931 of 23,160, 23,551, and 21,029 a total of 67,740 tons. In the first three quarters of 1930 the exports were 72,322 tons and in the corresponding period of 1929 they were 82,911 tons.

In addition, the preliminary reports from the five leading export centres for native rubber shew a further sharp increase for the month of October, being 6,923 metric tons, as compared with 5,419 metric tons in September and 5,615 metric tons in August. Had not the rise in price of rubber coincided with the padi planting season which absorbed considerable labour, an even higher production of rubber would have resulted.

The following are amongst the pertinent observations extracted from the various native rubber reports.

Acheen and Dependencies. The increased price resulted in a noticeable increase in production in the country about Langsa during September. While in August all the tapping was performed by family labour, during September tapping was done by outside labour according to the "bagi dua" system whereby half the rubber goes to the tapper and half to the owner of the trees; or by the "bagi tiga" system when two-thirds of the rubber becomes the property of the tapper. In some of the larger holdings tappers were hired for wages. The owners of these plantations did this as a speculation with the hope of seeing a further increase in prices and they therefore held on to their rubber.

Statistics were collected regarding tapping on small holdings. On an average, it appears that one man tapped about 360 trees per day; the average

daily production per tapper was about 5.4 kati (7.4 lbs.) of slab rubber; each tapper worked about 4½ hours in order to secure this average production.

Langsa is at present the only place where rubber is being bought up. Therefore, it is around this market that holdings are being exploited. Under existing prices and considering transport costs, it would not appear likely that holdings more than ten kilometres distant from Langsa will be exploited.

Sumatra West Coast. Tapping activities varied with the price of rubber. During the third quarter 3,051 piculs of slab rubber were shipped out of the province from Bang Kinang to Pekan Baroe, while from Batang Hari a total of 835 piculs were shipped to Djambi.

In addition to family labour, the "bagi dua" system was employed. In some cases, the tapping coolies received the entire amount of rubber which they produced because the owners desired to retain the labour in the hope of possible price increases.

Taparoeli. There was practically no tapping in July and August. More interest was displayed, however, in September owing to the further advances in the price of rubber. In spite of the price decline at the end of Septembr, it is expected that October exports will show a decided increase over preceding months.

Palembang. Heavy increase in exports followed the higher prices at the end of August and beginning of September.

Western Division of Borneo. Exports increased and reached the peak in the first quarter of 1932. Larger export was partly due to the shipping of old stocks. The want of cash among natives is so great and the opportunity for securing money so small that each and every increase in prices will witness an increase in the production of rubber.

Southern and Eastern Division of Borneo. The great increase of export in August and September must be ascribed entirely to the increased tapping as a result of the higher prices.

The revival of the rubber trade immediately affected the entire economic life of the Hoeloe Sungei division. In August and September the markets were crowded. Large quantities of small pails, knives, cups etc. were again supplied. The prices of water buffaloes sold in Pleihari to Hoeloe Soengei rose with the rubber prices. In the sub-district of Tandjoeng it was requested in a few kampongs that school time be changed again to the afternoon so that children could do tapping work in the morning.

Tapping was performed almost entirely by family labour. The large holdings have not yet been taken into tapping.

Outside the Hoeloe Soengei area, although a little later, increased tapping was recorded.

Reviews.

Cacao.

BY

C. J. J. VAN HALL.

Second Edition. 504 pages and index; 176 illustrations.
Macmillan & Co., Ltd., London, 1932. Price 28 shillings.

The appearance of a second edition of Dr. van Hall's important book on the cacao industry, originally published in 1914, is opportune. In combination with other major tropical crops, recent research has resulted in considerable additions to knowledge regarding cacao, its cultivation and production.

The book is divided into eleven chapters dealing with the following subjects —history, origin and present distribution, chemistry, botany, varieties, cultivation, selection, preparation, pests and diseases, cacao-growing countries and characteristics of marketable beans. The chapter dealing with selection is a new one and consists of a concise account of the comparatively small amount of work which has been done in this direction with cacao. In view of the increasing realisation of the importance of compatibility between stock and scion, the selection of cacao-stocks compatible with desirable scions might well have been suggested. All aspects of the cultivation of this crop are dealt with in considerable detail, such information being augmented by a description of the methods employed in the principal cacao-producing countries throughout the tropics. The general presentation of the subject matter and numerous illustrations combine in the production of an excellent agricultural handbook, invaluable to those interested in cacao cultivation.

Since Malaya is not a cacao-growing country it is unnecessary to review the subjects dealt with any degree of detail. It is of interest, however, to record the conditions obtaining in the cacao-producting districts of Ceylon and Java, where the average annual export is 4,000 and 1,200 tons, cacao respectively. As a comparison, mention should be made of the Gold Coast which exports 230,000 tons; some 44 per cent. of the world's production. Cacao is successful in Ceylon only between 500 and 2,000 feet elevation. The rainfall averages between 60 and 80 inches per annum. The soil is chiefly alluvial. The combination of rainfall, temperature, and elevation required for the profitable cultivation of cacao eliminates many districts for this product. Almost all the cacao produced is restricted to a comparatively small area centering round Kandy and Matale. In the Dutch East Indies cacao plantations are found principally in the regencies of Semarang, Soerakarta, and Pekalongan in Central Java. The estates are mostly situated on the slopes of mountains at altitudes ranging from 500 to 1,800 feet. A few

Note on the spelling of "Cacao":—The common Anglicised spelling *i.e.* Cocoa, is a corruption of the above and is now taken to refer to the powder made from crushed cacao seeds.—*Ed.*

estates occur at lower altitudes, near the sea-coast. The cacao trees suffer no ill effect from droughts of several weeks, often experienced during the months of July, August and September.

At the Experimental Plantation, Serdang, Selangor, several attempts by the Department to cultivate cacao experimentally have failed. Occasionally, however, individual trees are met with which have made comparatively good growth, and produce pods of fair quality. It appears doubtful, therefore, whether cacao might be grown with any real success on the plains in Malaya. The possibility of cultivating this crop on the hills at medium elevations is a matter worth investigating when the opportunity occurs.

J. N. M.

A Manual of Green Manuring.

Prepared by the Department of Agriculture, Peradeniya, Ceylon. 190 pages, 34 illustrations and figures. Price Rs. 5s, postage extra. Obtainable from the Manager, Publication Depot, Peradeniya.

The collection of a series of investigations, upon green manuring in Ceylon, published during recent years in the *Tropical Agriculturist,* and now issued as a separate manual, provides a valuable compendium of information to tropical agriculturists. The subject matter is divided into seven sections. Section I deals with the principles of green manuring and their application in Ceylon. Sections II to V are concerned with the use of green manures with the following major crops:—tea, coffee, cacao, rubber, coconuts, and padi. Further sections are devoted to fungus diseases of certain green manures and their relation to diseases in the main crop, and the more important insect pests by which green manures are liable to be attacked. Since the crops enumerated, with the single exception of cacao, are cultivated in Malaya, it is obvious that the experience of agricultural workers in Ceylon is likely to be of utility under similar circumstances in this country. In general, this is found to be the case. The list of references at the end of each section, facilitates detailed study of the particular subject where such is desired.

In Section I, an account is given of the advantages obtained in Ceylon from green manuring and their employment in other tropical countries. By the judicious use of green manures, including cover crops, the nitrogen and carbon contents of the soil are maintained, its physical condition and moisture-retaining capacity improved, and erosion prevented. The amount of nitrogen supplied to the soil by the employment of leguminous crops is shown to be considerable where abundant nodules are present. In cases where nitrogen is not increased, cover plants prevent loss of nitrogen as nitrates by leaching in the early stages of establishment by the main crop. A legume providing an average crop of

4 tons of green material per acre per annum, containing .6 per cent. of nitrogen, will add to the soil at least 50 lbs. per acre of the latter. Local experience at the Government Experimental Plantation, Serdang, indicates that 4 tons of dry matter per acre is obtained from three-monthly prunings of *Crotalaria anagyroides* during the first year of its growth. With regard to the conservation of soil moisture, work at Peradeniya indicates that during the first two years growth of cover crops, an excess of surface moisture is lost through transpiration, but this is reversed once the cover is well established and a layer of organic matter has formed a surface mulch. It has been shown by Belgrave (*Malayan Agricultural Journal*, vol. XVIII, page 492) that on flat land at the Government Experimental Plantation, Serdang, no such loss occurred even during the early stages of growth. Typical analyses of leguminous and non-leguminous plants are appended. These can only, however, be taken as a rough guide, since variations may be expected owing to different conditions of growth at the time of sampling.

In the sections dealing with the use of various leguminous trees and herbs with individual crops, much useful information is adduced. The experience obtained with tea is of particular value, since many years of investigation in Ceylon must, of necessity, be of considerable assistance in the successful establishment of this new crop in Malaya. A large variety of leguminous plants are dealt with and provide a useful reference when such plants are under consideration in this country.

The illustrations are clear and serve a useful purpose in assisting the ready recognition of the various species described. An adequate index of the plants, and pests and diseases, referred to is appended.

J. N. M.

Departmental.

FROM THE DISTRICTS.

The Weather.

On the west of the main range very wet weather was experienced generally throughout the month. Heavy downpours resulting in floods occurred in Province Wellesley and Penang towards the end of the month. Similarly the rainfall over the greater part of Perak and Selangor was above the average. In west Pahang and in Kelantan the rainfall was about average for November.

Remarks on Crops.

Rubber. The price of rubber remained fairly constant throughout the month and was little changed from that given for last month. The wet weather hampered tapping in most districts and this was especially remarked upon in parts of Province Wellesley, Perak and Selangor. As usual, under such conditions, Mouldy rot was very much in evidence in all infected areas. Floods and strong winds experienced in Province Wellesley resulted in the uprooting of several hundreds of rubber trees in certain localities.

Padi. At the Bagan Serai Government Rice Mill the price of padi was the same as for last month namely $1.80 per picul equivalent to about 7 cents a gantang. No appreciable change in the prices in other areas took place.

In parts of South and Central Kedah and in certain localities in the Bagan Tiang and Parit Buntar mukims of Krian, planting was still not quite completed at the end of the month. In these late planted areas only a poor or at least a medium crop can be anticipated. Damage by floods is reported from Balik Pulau District in Penang and from Province Wellesley South as well as from the Kulim District of Kedah and from Selama in Perak. In general, however, only minor damage has been sustained and reports from Province Wellesley indicate that the crop in many cases withstood temporary submergence with very little apparent damage. Crop prospects are generally good for North Kedah, Province Wellesley and most of Perak excluding Krian. In this important rice area prospects are variable. A good crop is expected to be produced in the mukims of Bagan Serai, Briah, Selinsing and Gunong Semanggol. The presence of very late planted areas in Kuala Kurau mukim and to a lesser extent in the Tanjong Piandang and Parit Buntar mukims, make prospects very uncertain in such areas. In the coastal areas of Kelantan harvesting was carried out very rapidly and was completed by about the middle of the month which was fortunate as heavy rain on the 20th flooded the harvested fields. In Selangor harvesting was completed in all the inland districts with the exception of Ulu Langat, and yields, on the whole, were moderately good, whilst in the coastal districts transplanting had just commenced. A good crop is anticipated in the Negri Sembilan, and in Pahang the total crop is expected to be in excess of any yet recorded, partly on

account of a very considerable increase in the area planted.

Coconuts. A rather more detailed report than usual on the coconut position in the coastal districts of Selangor is provided this month by the Agricultural Field Officer. There has been a considerable falling off in yields generally during the past two months, especially in areas that are poorly drained. As a result of these small yields and the consequently, higher prices for nuts for copra manufacture, there has been no export of nuts to Ulu Selangor during the month with the result that supplies in that District are extremely short.

The present position regarding copra production by small holders may be roughly summarised. In Sabak Bernam there are approximately 150 kilns the majority of which are of a crude type. There are five manufacturers in this District who produce a high class quality of copra and efforts still continue to effect improvement in the poorly built kilns. In Kuala Selangor progress is well sustained. The owner of the first clay-walled kiln built at Jeram has started to convert this into a more substantial brick-walled kiln, whilst the owner of the large kiln at Api-Api is carrying out extensions in order to cope with the larger number of nuts he is now receiving. In Klang three out of fourteen of the Malay kilns are producing good quality copra. In Kuala Langat the building of kilns has been too rapid to allow of the proper Departmental supervision of their construction, with the result that there are a large number of inefficient kilns and only a few really satisfactory ones. Some improvement, however, has been effected,especially at Kanchong Darat and Batu where good average estate quality copra is now being produced. Efforts towards further improvement of the position are being contined. Progress towards the increased manufacture of copra by the small-growers themselves is reported from Province Wellesley, Bagan Datoh and Johore.

Agricultural and Padi Experiment Stations and Test Plots.

Kedah. The construction of a solar propagator was completed at Gajah Mati Agricultural Station.

Perak. At the Titi Serong Padi Station heavy rain at the end of October caused considerable damage to recently planted, short maturation period padi. Similar damage was also reported to have taken place at Lenggong Test Plot where the area planted with Radin varieties was submerged on three occasions. At the Tanah Rata Experiment Station, Cameron Highlands, the pruning of the tea planted in 1931 and the ploughing of fields under variety trials has been completed.

DEPARTMENTAL NOTES.

Tour of the Director of Agriculture.

Dr. H. A. Tempany, Director of Agriculture, S.S. & F.M.S., made a tour of the Raub and Kuala Lipis Districts of Pahang and of the riverine areas from Jerantut to Temerloh, between the 9th and 13th of October. He was accompanied by the Agricultural Field Officer, Pahang.

Government Dairy and Poultry Farm, Fraser's Hill.

The livestock at the Government Dairy, Fraser's Hill, at the end of October, comprised 30 cows, 23 of which are in milk; 1 heifer, 1 stud bull, 1 young bull and 9 calves: a total of 42 animals. The stock, with the exception of one heifer calf which died of colic, was very healthy. During the latter part of October the calves were fed on separated milk to which was added 2.5 per cent. of palm oil in order to replace the deficiency of fat content: this new diet appeared to be highly satisfactory.

The poultry stock in October consisted of 60 pure bred, 12 cross bred and 8 native birds: 6 of the cross bred hens were imported from Seremban during the month.

Tobacco Curing at the Government Experimental Plantation, Serdang.

A flue curing barn for tobacco leaf was completed in October and an attempt to cure a small quantity of Virginia cigarette tobacco was made; although the barn was only about one quarter full, with the consequent difficulty of controlling the humidity of the air, a fair measure of success was obtained.

Mycological Division.

Among the other numerous activities of this Division, experiments were carried out on the pink mould (*Trichothecium sp.*) which is commonly found on copra after periods of rain, in order to determine whether it is injurious to the product. It was proved that this mould is incapable of penetrating the copra tissues and although numerous spores are produced, they do not appear to take any active part in copra deterioration.

Further research work was carried out on the fungoid diseases of oil palms, coffee, yams, tomatoes and several other minor crops. A site for an experimental bed for the culture of mushrooms was chosen at the Cheras Agricultural Station and arrangements were being made to carry out a series of experiments with the spawn obtained from a local species (*Volvaria volvaceae*).

Soil Survey in Pahang.

An area which has been proposed for the cultivation of padi at Triang Ilir, Pahang, a portion of which extends over the Negri Sembilan border, was visited in November by Mr. Wilshaw, Assistant Chemist, Soils, with the object of

obtaining soil samples in order to determine its suitability for the growing of this crop.

Agricultural Shows at Kuala Selangor and Kajang.

An agricultural show was held for the first time at Kuala Selangor on November 10th, under the auspices of the Malayan Agri-Horticultural Association.

The exhibition embraced sections for vegetables, fruit, copra, padi, other minor economic crops, poultry and village industries. The quality and quantity of the peasant produce was very satisfactory. The excellence of some of the exhibits in the poultry section is deserving of special mention : the copra entries, on the other hand, were somewhat disappointing from so large a copra-producing district as Kuala Selangor.

Advantage was taken of the opportunity for educational propaganda by several Government Departments, notably by the Department of Agriculture which staged very instructive exhibits of copra and copra manufacture, methods of rat destruction and the cultivation of yams and other minor crops; other special exhibits were displayed by the Health, Infant Welfare and the Co-operative Departments.

A well attended Agricultural Show was also held at Kajang on the 13th. of November, comprising a representative display of the more important agricultural products of the District.

Bulletin of Malayan Agricultural Statistics.

This bulletin, which was published by the Department of Agriculture in November 1932, is the first of a new Economic Series; it comprises statistical information on the planted areas, production and exports of all the major economic crops together with the imports and exports of minor crops and other products closely related to agriculture.

A meteorological summary and a table showing the average annual prices in Singapore of the more important agricultural products between the years 1922 and 1931 is also included.

The bulletin is on sale at all booksellers and at the Department of Agriculture Kuala Lumpur at 50 cents per copy.

Supplement to Special Bulletin No. 83.

A supplement to Special Bulletin No. 38 "A Preliminary List of Food-Plants of Some Malayan Insects" was published by the Department on November 25th, 1932. This Supplement is published in a limited edition. Copies have been despatched to various institutions whose names are included on the exchange list of publications. This publication is of a technical character and owing to the present need for economy will not, therefore, be distributed to general subscribers except on application.

Appointment.

Mr. H. D. Meads has been appointed Temporary Assistant to the Deputy Registrar-General of Statistics, Kuala Lumpur, with effect from 1st October, 1932.

Leave.

Mr. F. W. South, Chief Field Officer, has been granted 9 months and 13 days leave on full pay, with effect from 23rd November, 1932.

Mr. F. Birkinshaw, Senior Agricultural Officer, Perak North, returned from leave of absence on 11th November, 1932, and will be acting in the capacity of Chief Field Officer during the absence of Mr. South.

Mr. F. de la Mare Norris, Principal Agricultural Officer, Johore, returned from leave of absence on 19th November, 1932.

Mr. T. A. Buckley, Assistant Chemist, returned from leave of absence on 17th November, 1932.

Retirement.

Mr. H. Ritchings, Horticultural Assistant, retires from the Government service with effect from 26th December, 1932, on the expiration of his present leave of absence, by reasons of the abolition of appointment under Section 8 (ii) (*e*) of the Pensions Enactment 1928.

Mr. H. T. Pagden, Assistant Entomologist, retires from the Government service with effect from 24th December, 1932, on the expiration of his present leave of absence, by reason of the abolition of appointment under Section 8 (ii) (e) of the Pensions Enactment 1928.

ERRATUM.

Seeding of *Derris Elliptica.*

In line 16 of the article headed as above on page 582 of the November issue of this journal, for "2 ins." read "0.2 in.".

Statistical.

MARKET PRICES.

November, 1932.

Rubber.—The Singapore price of rubber smoked sheet, equal to London Standard in November varied from 7 7/16 cents to 8 8/16 cents per lb., the average from the month being 7.75 cents as compared to 7.47 cents in October. The average London price was 2.56 d. per lb. as compared to 2.25 d. in October, while the New York average price was 3.39 gold cents per lb. as compared with 3.66 gold cents in the previous month.

Palm Oil.—The price of Palm Oil, c.i.f. Liverpool on a basis of 18 per cent. f.f.a. was quoted throughout the first three weeks of November at £18.10.0 per ton with a rise to £18.15.0 during the last week. The market was reported to be steady.

Copra.—The market in Singapore was quite steady during November the price varying from $5.75 to $5.90 per picul. The average prices per picul for the month were as follows:—Sundried $5.81, mixed $5.28 as compared with $5.75 and $5.20 respectively in October. Copra cake was quoted throughout November at $2.10 per picul.

Coffee.—Singapore prices of Palembang coffee have varied but little during November, the average price per picul being $19.38 as compared with $19.56 for October. The average price of Sourabaya coffee was from $24.50 to $26.60 per picul as compared with $24.19 to $26.50 during the previous month, the price within this range depending upon quality.

Arecanuts.—The average Singapore price for Palembangs for November was $2.64 per picul is compared with $2.99 for October. Bila Whole averaged $2.81 per picul as compared with $3.24 in October. Average Singapore prices per picul of other grades in November were:—Splits $4.31 to $6.35; Red Whole $4.88 to $5.87; Sliced $5.75 to $8.75, the price within each range depending on quality. Kelantan Splits were unquoted.

Rice.—The following are the average wholesale prices per picul of rice in Singapore during October: Siam No. 2 $3.68: Rangoon No. 1 $3.41 as compared with $3.86 and $3.55 respectively in September.

The average retail market prices in cents per gantang of No. 2 Siam rice in October were:—Singapore 30, Penang 30, Malacca 28, as compared with 30, 30, and 27 respectively in September.

Gambier.—Prices in the Singapore market during November showed a tendency to decline. Average prices were:—Cube No. 1 $10.19 per picul and Block $5.88 per picul, as compared with $10.94 and $6.37 respectively in October.

Pineapples.—During November the Singapore market has been steady, the average prices per case were:—Cubes $2.95, sliced flat $2.84, and sliced tall $3.24, as compared with $3.07, $3.01 and $3.42 respectively in October.

Tapioca.—The Singapore market has been steady. Average prices per picul in November were :—Flake fair $3.32, Pearl seed $3.98 and Pearl medium $4.08. Corresponding prices in October were $3.32, $4.04 and $4.14.

Sago.—The average Singapore market prices per picul in November were :—Pearl, small, fair, $4.07, Flour, Sarawak, fair $2.29 as compared with $4.15 and $2.27 respectively in October.

Mace and Nutmegs.—The demand has been poor. Average prices per picul in Singapore were :—Siouw $62, Amboina $39.50 as compared with $64 and $41.25 respectively in October. Nutmegs 110 per lb. were $23.75 and 80 per lb. $29.50, the corresponding prices in the previous month being $24 and $33 per picul.

Pepper.—The average Singapore market prices per picul in November were :—Singapore Black $17.75, Singapore White $22.44, Muntok White $22.94. Corresponding prices in October were $18.31, $24.06 and $24.31.

Cloves.—Demand was poor, nominal prices only being quoted. The nominal prices per picul in Singapore throughout November were :—Zanzibar $40, Amboina $45, as compared with an average of $40.75 and $45.50 respectively for October.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Cumberbatch & Co., Ltd., Kuala Lumpur, and the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and four pence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Charing Cross, London S.W.1.

GENERAL RICE SUMMARY*

October, 1932.

Malaya.—Gross foreign imports of rice (including stocks available for re-export) during October, 1932, amounted to 46,332 tons as compared with 55,768 tons in October, 1931, of which 55.1 per cent. were consigned to Singapore, 11.3 per cent. to Penang, 8.1 per cent. to Malacca, 17.2 per cent. to the Federated Malay States and 8.3 per cent. to the Unfederated Malay States.

Of these imports 71.4 per cent. were from Siam, 25.7 per cent. from Burma, 1.6 per cent. from French Indo-China and 1.3 per cent. from other countries.

Total foreign exports of rice from Malaya in October, 1932, were 17,486 tons (including 150 tons local production exported from Penang).

Of these exports 83.8 per cent. went to the Netherlands East Indies and 16.2 per cent. to other countries.

The exports during October 1931 were 15,787 tons.

Net Imports for the period January to October, 1932, were 335,184 tons as compared with 446,676 tons for the same period of 1931, a fall of 25.0 per cent.

India and Burma.—Total foreign exports of rice (*Indian Trade Journal* 10.11.32) during September, 1932, were 144,000 tons as compared with 113,000 tons in August, 1932, and 115,000 tons in September, 1931, increases of 27.4 per cent. in respect of the previous month and 25.2 per cent. in respect of the same period of the previous year.

Total exports during period January to September, 1932, were 1,794,000 tons as compared with 1,671,000 tons for the corresponding period of 1931, an increase of 123,000 tons or 7.4 per cent.

Total exports of rice and bran from Burma for the period January 1 to October 29, 1932, amounted to 2,699,093 tons as compared with 3,107,232 tons for the corresponding period of 1931, or a decrease of 13.2 per cent. Of these exports 776,023 tons went to India in 1932, as compared with 1,255,974 tons in 1931, a decrease of 38.2 per cent.

The second forecast of the rice crop in Burma for the season 1932-1933 issued on November 15, 1932, gives the area likely to mature as 12,339,000 acres, being 70,100 acres or 0.6 per cent. more than the final figures of last season.

Japan.—According to the first rice-crop forecast for 1932, the yield is estimated at 8,633,841 tons, an increase of 11.5 per cent. over the crop of 1931. The area planted is estimated to be 7,974,260 acres, a slight increase on that of the previous year.

Formosa.—The estimated production of rice this year is 680,432 tons, being 26.4 per cent. more than that of 1931. The area under rice is 942,689 acres, an increase of 6.2 per cent. as compared to that of last year.

Siam.—Exports (approximate) of rice from Bangkok during October, 1932,

*Abridged from the Rice Summary for October 1932, compiled by the Department of Statistics, S.S. and F.M.S.

amounted to 129,769 tons as compared with 96,000 tons in October, 1931 or an increase of 35.2 per cent.

Exports of rice from Bangkok during the period December 1931 to October, 1932, (the figures for August, September and October, 1932, being approximate) amounted to 1,369,504 tons, an increase of 282,567 tons or 26.0 per cent. as compared with the same period of 1930 - 31.

At the end of September 1932 the area under padi in the provinces of the inner circle amounted to 6,428,896 acres, a decrease of 2,736 acres from the area under this crop at the same time last year.

Netherlands India.—Java and Madura. The *Korte Berichten* of November 4, 1932, states that at the end of September, 1932, the area harvested amounted to 8,405,250 acres, an increase of 353,500 acres or 4.4 per cent. as compared with the same period of 1931, the area damaged to 337,391 acres a decrease of 115,881 acres or 25.6 per cent. as compared with 1931 and additional plantings awaiting harvest to 1,016,750 acres an increase of 84,000 acres as compared with 1931, a total of 9,759,391 acres as compared with 9,437,772 acres for the same period of 1931 an increase of 3.4 per cent.

Imports of rice into Java and Madura during January to September, 1932, totalled 113,800 tons as compared with 226,990 tons for the same period of 1931, or a fall of 49.9 per cent.

Imports of rice into Outer Provinces during January to August 1932, totalled 167,481 tons as compared with 224,907 tons for the same period of 1931 or a fall of 25.5 per cent.

French Indo-China.—Entries of padi at the port of Cholon from January 1, 1932, to October 27, 1932, amounted to 968,606 (metric) tons, an increase of 4,315 tons or 0.4 as compared with the same period of 1931.

Exports of rice from Saigon for the period January 1, 1932, to October 31, 1932, amounted to 988,591 (metric) tons an increase of 146,617 tons or 17.4 per cent. as compared with the same period of 1931.

Ceylon.—Imports for 9 months September 30, 1932, were 339,023 tons, an increase of 8,799 tons or 2.7 per cent. as compared with 1931.

Of these imports 20.4 per cent. were from British India, 70.2 per cent. from Burma, 0.3 per cent. from the Straits Settlements and 9.1 per cent. from other countries (Cochin-China, Siam, etc.).

Europe and America.—During the period January 1st to October 20th, 1932, 862,337 tons were shipped from the East to Europe, as compared with 962,380 tons for the same period of 1931. Of the 1932 shipments 54.7 per cent. were from Burma and 34.9 per cent. from Saigon.

For the period January 1st to September 20th, 1932, 45,325 tons were shipped from the East to the Levant, a decrease of 17.1 per cent. as compared with the same period of 1931.

To the West Indies and America for the period January 1st to September 7th, 1932, 102,094 tons were shipped from the East, a decrease of 17,711, or 14.8 per cent. as compared with the corresponding period of 1931.

MALAYAN AGRICULTURAL EXPORTS, OCTOBER, 1932.

PRODUCT.	NET EXPORT IN TONS.				
	Year 1931	Jan-Oct 1931	Jan-Oct 1932	October 1931	October 1932
Arecanuts ...	19,266	16,113	16,121	1,319	680
Coconuts fresh ...	10,468	7,149½	100,607†	984½	10,637†
Coconut oil ...	9,909	8,129	9,212	717	1,080
Copra ...	100,809	79,580	78,147	8,752	12,196
Gambier, all kinds ...	2,563	2,203	2,546	279	142
Palm kernels ...	726	554	973	143	130
Palm oil ...	4,574	3,465	6,290	711	892
Pineapples Canned ...	59,457	49,127	56,703	2,011	2,239
Rubber ...	434,857	356,402	342,132	37,474	36,621
Sago—flour ...	5,608	2,001	7,478	2	916
„ —pearl ...	2,429	1,875	2,716	267	580
„ —raw ...	2,904*	1,758*	3,330*	307*	302*
Tapioca—flake ...	9,742	8,276	7,846	577	653
„ —flour ...	491*	267*	112*	158*	79
„ —pearl ...	19,006	15,936	16,564	1,614	1,193
Tuba root ...	74	48	105½	3½	7½

† '000 in number. * net imports.

ACREAGE OF TAPPABLE RUBBER OUT OF TAPPING IN NETHERLANDS INDIA AT THE END OF SEPTEMBER 1932.

	A Totally Ceased		B Partly Ceased		Total A & B	
	Estates	Area in acres	Estates	Area in acres	Estates	Area in Areas
Java and Madoera ...	227	139,683	46	15,593	273	155,276
Outer Provinces ...	210	93,494	59	28,911	269	122,405
Netherlands India ...	437	233,177	105	44,504	542	277,681

The total area for September amounts to 29 per cent. of the total tappable area as at the end of December 1931.

Received by the Statistics Department from the Central Bureau of Statistics, Batavia.

ACREAGE OF TAPPABLE RUBBER OUT OF TAPPING ON ESTATES OF 100 ACRES AND OVER, MALAYA, AT THE END OF OCTOBER, 1932.

State or Territory	Acreage of Tappable Rubber end 1931	Estates which have entirely ceased tapping		Estates which have partly ceased tapping		Total (3) + (5)	Percentage of (7) to (2)
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federated Malay States :—							
Perak	238,420	14,662	6.1	32,062	13.4	46,724	19.6
Selangor	294,030	17,703	6.0	37,685	12.8	55,388	18.8
Negri Sembilan	217,002	20,060	9.2	20,819	9.6	40,879	18.8
Pahang	35,122	8,122	23.1	4,419	12.6	12,541	35.7
Total F.M.S. ...	784,574	60,547	7.7	94,985	12.1	155,532	19.8
Straits Settlements :—							
Province Wellesley	44,055	3,229	7.3	8,699	19.7	11,928	27.1
Dindings	6,700	504	7.5	1,205	18.0	1,709	25.5
Malacca	110,288	5,054	4.6	21,771	19.7	26,825	24.3
Penang Island	1,585	776	49.0	54	3.4	830	52.4
Singapore Island	28,033	13,014	46.4	3,981	14.2	16,995	60.6
Total S.S. ...	190,661	22,577	11.8	35,710	18.7	58,287	30.6
Unfederated Malay States :—							
Johore	313,385	43,127	13.8	34,867	11.1	77,994	24.9
Kedah (*a*)	114,254	11,114	9.7	7,112	6.2	18,226	16.0
Kelantan	16,785	6,808	40.6	1,181	7.0	7,989	47.6
Trengganu (*b*)	4,300	Nil	Nil	2,072	48.2	2,072	48.2
Perlis	903	106	11.7	462	51.2	568	62.9
Total U.M.S. ...	449,627	61,155	13.6	45,694	10.2	106,849	23.8
Total Malaya ...	1,424,862	144,279	10.1	176,389	12.4	320,668	22.5

Notes :—1. (*a*) Registered companies only and are rendered quarterly, commencing with June 1931.
(*b*) Registered Companies only.

The above table together with a Summary was prepared and published by the Statistics Department, S.S. and F.M.S. on October 26, 1932.

MALAYA RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF OCTOBER, 1932 IN DRY TONS.

Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month		
								during the month		during the year 1932		during the month		during the year 1932				
	Ports	Dealers	Estates of 100 acres and over	during the month	during the year 1932	during the month	during the year 1932	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MALAY STATES :—																		
Federated Malay States	...	14,154	11,360	11,494	116,669	8,576	76,442	Nil	Nil	Nil	Nil	12,415	6,397	137,424	58,969	...	15,039	11,709
Johore	...	2,795	3,080	3,771	36,520	4,213	34,738	Nil	8	Nil	64	909	7,100	9,785	61,538	...	2,831	3,027
Kedah	...	597	1,781	2,322	22,584	1,116	9,435	Nil	Nil	Nil	Nil	595	2,487	6,630	25,262	...	735	1,999
Perlis	...	35	14	10	66	5	58	Nil	Nil	Nil	Nil	Nil	20	Nil	114	...	32	12
Kelantan ...	...	195	140	166	1,441	296	2,294	61	Nil	394	Nil	84	447	490	3,524	...	176	151
Trengganu ...	...	55	50	97	1,035	48	519	Nil	Nil	Nil	Nil	Nil	145	Nil	1,554	...	55	50
Total Malay States	...	17,831	16,425	17,860	178,315	14,254	123,486	61	8	394	64	14,003	16,596	154,329	150,961	...	18,868	16,948
STRAITS SETTLEMENTS																		
Malacca ...	...	3,456	1,287	1,422	13,475			Nil		Nil		4,582		40,754		...	3,609	1,361
Province Wellesley	...	138	485	470	4,466			Nil		Nil						...	120	646
Dindings ...	...	186	94	77	910	2,373	19,922	Nil	16,616	Nil	151,113	5,388	Nil	51,755	Nil	...	99	76
Penang	463	4,594	9	5	26			451		3,963						655	4,286	11
Singapore ...	3,890	15,248	215	160	1,532			6,990		52,845		13,958		151,198		3,786	18,156	215
Total Straits Settlements	4,353	23,622	2,090	2,134	20,409	2,373	19,922	7,441	16,616	65,808	151,113	23,928	Nil	243,707	Nil	4,441	26,270	2,309
TOTAL MALAYA	4,353	41,453	18,515	19,994	198,724	16,627	143,408	7,502	16,624	57,202	151,177	37,931	16,596	398,036	150,961	4,441	45,138	19,257

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Total
20	21	22	23	24	25	26
DRY RUBBER	12,158	15,376	3,819	3,557	1,128	36,038
WET RUBBER	2,881	2,780	467	271	1,703	8,102
TOTAL ...	15,039	18,156	4,286	3,828	2,831	44,140

TABLE III
FOREIGN EXPORTS

PORTS	For month	during the year 1932
Singapore ...	23,865	247,717
Penang ...	8,397	91,279
Port Swettenham.	4,138	50,577
Malacca ...	1,531	8,463
MALAYA ...	37,931	398,036

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	during the year 1932
Malay States ...	30,735	340,356
Straits Settlements		
MALAYA ...	30,735	340,356

Notes :—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [19A] — [2] — [3] — [4] — [5] — [9] — [10]. For the Straits Settlements, Columns [7] and [8] represent purchases by dealers from local estates of less than 100 acres, reduced by 15% to terms of dry rubber.

3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15%; wet sheet, 25%; scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.

4. Domestic exports are estimated by deducting the average monthly dry weight of foreign imports over a period of 2 months from the gross foreign exports of the later month, the foreign exports of the Malay States being domestic production.

5. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 21st October, 1932.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1932.

Locality	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .05 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						hr.	hr.	%
Railway Hill, Kuala Lumpur, Selangor ...	89.7	72.0	80.9	94	70	85	74	83.9	84.6	9.98	253.5	1.76	22	19	4			138.25	4.46	37
Bukit Jeram, Selangor ...	87.5	72.3	79.9	90	70	84	74	83.1	85.3	12.35	313.7	1.43	21	18			1	164.85	5.32	44
Sitiawan, Perak ...	88.8	73.2	81.0	94	71	81	75	83.6	85.0	8.86	225.0	1.99	23	19	4	2		157.25	5.07	42
Kroh, Perak ...	85.3	70.6	77.9	90	69	77	72	81.3	82.2	14.42	366.3	2.44	27	21	3	5		147.00	4.74	39
Temerloh, Pahang ...	88.5	72.7	80.6	92	71	81	75	84.6	85.5	6.12	155.5	2.26	13	10	2	14		129.65	4.18	35
Kuala Lipis, Pahang ...	87.9	71.9	79.9	92	70	81	74	83.0	84.4	7.85	199.4	2.35	19	14		23		137.75	4.44	37
Kuala Pahang, Pahang ...	86.4	74.3	80.5	89	73	80	76	86.3	86.5	5.16	131.1	1.64	18	15	1			184.20	5.94	49
Mount Faber, Singapore ...	87.3	74.9	81.8	91	72	81	78	82.4	83.4	3.57	90.7	0.67	21	16	4		1	169.65	5.47	45
Butterworth, Province Wellesley ...	86.4	74.0	80.2	90	72	79	76	83.8	84.7	14.57	370.1	2.39	22	18		1		173.95	5.61	47
Bukit China, Malacca ...	84.8	73.6	79.2	87	72	80	75	82.8	84.2	8.29	210.6	1.30	17	14	4			187.90	6.06	50
Kluang, Johore ...	87.9	71.4	79.7	90	68	79	74	81.7	82.3	13.23	336.0	3.19	20	14	3	4		144.05	4.65	38
Bukit Lalang, Mersing, Johore	86.6	72.1	79.3	89	71	78	74	81.4	81.8	8.31	211.1	1.57	14	12	3			162.60	5.25	43
Alor Star, Kedah ...	86.7	74.5	80.6	91	72	80	77	85.6	86.0	13.20	335.3	2.24	22	21	7	1		166.85	5.38	45
Kota Bahru, Kelantan ...	86.5	73.7	80.1	91	72	75	75	83.9	85.0	12.16	308.9	2.47	21	20				156.35	5.04	42
Kuala Trengganu, Trengganu	86.3	73.1	79.7	90	70	77	75	83.0	84.5	14.69	373.1	4.22	19	18	2			168.90	5.45	45
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft. Pahang ...	72.7	62.3	67.5	79	60	67	64	71.1	71.7	13.09	332.5	2.86	21	20	1	8	2	119.55	3.86	32
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	71.7	58.6	64.9	75	53	65	62	69.4	69.4	13.06	331.7	2.21	27	21	2	7		100.15	3.23	28
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	70.3	59.4	64.9	75	58	64	61			12.89	327.4	2.71	27	20		2		103.25	3.33	28

Compiled from Returns supplied by the Meteorological Branch, Malaya.